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**RESEARCH AND DEVELOPMENT
EFFECTIVENESS PROGRAM 1969 (RDE 69)**

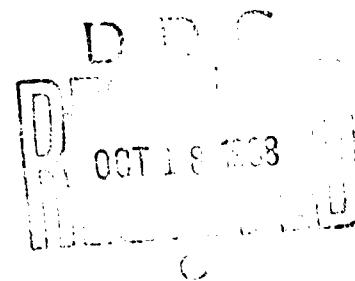
**A MANAGEMENT TOOL TO ALLOCATE THE BUDGET
OF A RESEARCH ORGANIZATION**

ROBERT R. JURICK

JAMES F. BITTLE, II

TECHNICAL REPORT ASD-TR-68-23

JULY 1968



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DEPUTY FOR ENGINEERING
AERONAUTICAL SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

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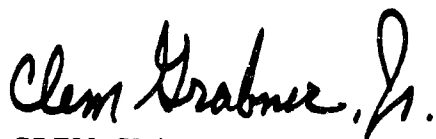
*ROBERT R. JURICK
JAMES F. BITTLE, II*

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FOREWORD

This report has been prepared by Robert R. Jurick and James F. Bittle, II of the Digital Computation Division, Directorate of Computation Services, Deputy for Engineering, Wright-Patterson Air Force Base, Ohio. It consists of information necessary to use the RDE69 computer program written for the Plans group of the Air Force Flight Dynamics Laboratory at Wright-Patterson Air Force Base, Ohio. This group, charged with development and implementation of the program, is comprised of Mr. A. B. Nutt, Mr. J. F. Schmidt, and Lt M. D. Rusk. The RDE69 programming effort began in August 1967. This report was submitted by the authors on April 19, 1968.

This technical report has been reviewed and is approved.



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ABSTRACT

A formulation and digital computer program is presented as a management tool to allocate the budget of a research organization. It has been designed to meet the specific needs of the Air Force Flight Dynamics Laboratory at Wright-Patterson Air Force Base, Ohio, but instructions are included to enable the program to be used by any research organizations. The value of a specific research task is defined and an optimization technique is employed to maximize the total value achieved for a given yearly budget constraint of the organization. A maximum of 250 research tasks may be considered. The program performs a yearly optimization for up to five years. It generates a number of reports which indicate the progress of each research task during the given time period and the effect of this progress on other organizational entities.

TABLE OF CONTENTS

SECTION	PAGE
I INTRODUCTION	1
II MATHEMATICAL FORMULATION	4
1. Definitions of Terms	4
2. Problem Description	5
3. System Flow Diagram	9
4. Description of Routines	12
a. EDIT	12
b. EXEC	14
c. INIT	14
d. BJP	15
e. SMLP	15
f. FNAL	21
g. FACT	22
5. Applications and Limitations	22
III INPUT-OUTPUT DESCRIPTION	26
1. Description of Input and the Input Form	26
2. Program Constants	33
3. Examples of Output Reports	34
IV PROGRAMMING GUIDE	47
1. Running the program	47
2. Programming Notes	47
3. Listing of All Routines	52
APPENDIX I INSTRUCTIONS SENT OUT BY AFFDL TO TASK ENGINEERS	81
APPENDIX II SAMPLE INPUT DATA FOR SPECIFIC TASK	121

ILLUSTRATIONS

FIGURE		PAGE
1.	RDE Logic Flow Diagram	7
2.	Cost Versus Confidence Level Graph	17
3.	Timeliness Function Graph	19
4.	Sample Input Form	32
5.	Sample Input Data Listing	34
6.	Sample System Support Versus Task Matrix	35
7.	Sample Adjusted System Support Versus Task Matrix	36
8.	Sample Technological Objective Support Versus Task Matrix	37
9.	Sample Limited War Support Versus Task Matrix	39
10.	Sample 1498 Associated Work Units List	40
11.	Sample Priority List	41
12.	Sample Annual Report	43
13.	Sample Final Report	44
14.	Sample System Profile	45
15.	Sample Facility Utilization Report	46
16.	EDIT Deck Setup	48
17.	RDE69 Deck Setup	49

VARIABLE NAMES AND SYMBOLS

VARIABLE	FORTRAN NAME	DESCRIPTION
b_j	BJ	Contribution of task to system j
b'_j	BP	Adjusted b_j from equations (2a) and (2b)
\bar{b}_j	CAVG	Average contribution of all tasks to system j
B_k	BPSUM	Total system contribution for a given task
c_j	CJ	AFFDL designated weight of system j
C_k	COST	Cost of resource level k for a given task including converted engineer costs
CENG	CENG	Cost of employing one engineer for one year
CL	CLY	Confidence level at end of preceding year
CL'_k	CLNU	Confidence level attainable if RL_k funds are used
CLH	CLH	Confidence level array for years preceding first year of optimization
CS_k	CS	Contract and support funds used at RL_k
d	AR	Ranking factor in value coefficient equation
D_n	DN	Number of tasks in division n
EC_k	EC	Contract engineers used at RL_k
EI_k	EI	In-house engineers used at RL_k
g_j	TG	Contribution of task to tech objective j
h_j	HK	AFFDL designated weight of tech objective j
R	IR	Rank of task within its division
RL_k	NRL	Resource level k for a given task

VARIABLE NAMES AND SYMBOLS (CONT'D)

VARIABLE	FORTRAN NAME	DESCRIPTION
RDE_k	OBJ	Value coefficient for RL_k
t_j	TBJ, TGK	Expected time-to-completion for systems or tech objective as determined by AFSC
T_k	TGSUM	Total tech objective contribution for a given task
$T_{k,j}$	TIM	Timeliness factor of value coefficient equation
y_k	T8	Time in years for task to reach a confidence level of .8

SECTION I

INTRODUCTION

The Research and Development Effectiveness program (RDE) is designed to optimize the selection of tasks to be funded in a scientifically oriented organization which is constrained to a limited budget. It has been developed to meet the needs of the Air Force Flight Dynamics Laboratory (AFFDL) at Wright-Patterson AFB, Ohio; however, this documentation has been prepared to satisfy the interest shown by private industry and other Air Force agencies.

The problem of objectively allocating applied research resources within a large laboratory has basically two components: (1) the estimation of the potential value of an advancement in the state of engineering technology; (2) the alternative ways and costs associated in making this advancement. The research manager's function is to continually make choices among a large number of ways to spend resources. He must decide (1) what projects and tasks should be funded; (2) what rate of funding should apply; (3) whether the effort should be in-house or contract. Prior to the use of this program the allocation decisions were often the result of a loose interaction between requirements based on need, priorities as assigned by higher headquarters, and notions of costs and diminishing returns based on experience.

One often-used method of allocating resources is to list the possible projects in order of priority and then to fund each project successively until no more resources are left. This method often results in low cost projects of relatively low priority being ignored. Such a method has also another fundamental weakness in that it is very difficult to say just what level of funding is enough for any particular project. Fortunately it is possible to devise criteria for task selection which incorporate measures of both value and cost. Often it is not easy to develop these measures of cost and benefit objectively. Furthermore, it is humanly impossible for one individual to perform simultaneous evaluations of a multitude of competing projects. And a nonsimultaneous comparison, for example, may result in the allocation of resources on something very close to a first come, first served basis.

In light of the above problem, in 1962 the Chief of the Aeromechanics Directorate, Aeronautical Systems Division, assigned Capt. Robert H. Rea, in the Plans Office, to look into the possible ways that allocations of resources might be accomplished. During the course of his studies and investigation, he obtained the assistance of Lt. Thomas W. Synnott, an instructor in economics in the Department of Systems Management, Air Force Institute of Technology. Lt. Synnott suggested the use of Mathematical Programming as used in Capital Budgeting Problems, as described in a Doctoral Dissertation by H. Martin Weingartner. A linear programming approach was applied, a mathematical model was developed, and a trial run was made in 1964 - 65 for the FY 65 program. Each subsequent year improvements and changes have been made to the model, input data, and output formats. Beginning in 1965 (RDE66 program), the M40 linear programming routine was used in the solution of the allocation problem. In 1968 (RDE69 program) the linear program was abandoned in favor of a simplified program because, due to severe budgetary limitations, a single critical variable expressed in dollars was found to be adequate. The ratio of objective function (or merit factor) divided by cost in dollars is used as a ranking function.

The above, regardless of solution method employed, carries the basic objective of providing a decision aid for the Laboratory Director in utilizing the resources of the Air Force Laboratory in an effective manner.

The remainder of this report is composed of three parts; mathematical formulation, description of input and output, and a programming guide. Section II is intended to familiarize the user with the mathematical and logical structure of the program. A complete understanding of this section is necessary before the program can be expected to produce meaningful results. In addition, a thorough knowledge of the formulation is required before changes to the code can be attempted.

Section III describes in detail the preparation of the input data cards.

Finally, Section IV contains complete program documentation, and is supplied so that the user may easily tailor the program to his specific needs. In order that the program be essentially machine independent, the bulk of the code is written in FORTRAN.

ASD-TR-68-23

Although this report is intended to be primarily a programmer-user manual, Appendix I is included to show how the input information is obtained from the project engineers. "Format I," which the engineer fills out, is then translated to AFFDL Form 15 which is the computer input form. Appendix II contains a sample FORMAT I for task 134702. This task is then used as the example task for all reports.

SECTION II

MATHEMATICAL FORMULATION

1. DEFINITIONS OF TERMS

- 1498 WORK UNIT - An individual effort within a task.
- CONFIDENCE LEVEL - A measure of the progress of a task. Its range is from .2 to .8 with the effort necessary to achieve each even-tenth being defined by the task engineer.
- DIVISION - The largest sub-organization of the Flight Dynamics Laboratory. The five divisions of AFFDL are:
 - (1) Structures
 - (2) Flight Mechanics
 - (3) Flight Control
 - (4) Vehicle Dynamics
 - (5) Vehicle Equipment
- FACILITY - A test or support facility such as a wind tunnel or digital computer.
- PROJECT - A group of tasks that cover a given technical area within a technical domain (division).
- RESOURCE LEVEL - A description of the funding level of a task. A task is funded at resource level one if it receives its requested contract and support funds. A task is funded at resource level two if it receives the contract and support funds associated with double engineering manpower.
- SYSTEM - An AFSC approved system such as anti-ballistic missile or AMSA.
- TASK - A subdivision of a project. It is the basic funded element of AFFDL.
- TECHNOLOGICAL OBJECTIVE - An approved goal of a division such as better instrumentation or improved reliability for a given function.

- VALUE COEFFICIENT - A number associated with each resource level of each task. It represents the tasks contribution to the overall effectiveness of AFFDL at a given resource level.

2. PROBLEM DESCRIPTION

The management problem of obtaining maximum production for a given capital outlay becomes more complicated when the product is as intangible as technology. How is maximum technology output measured? How can the progress of one scientific effort be predicted when it is dependent upon the progress of many other scientific efforts? What is a basic unit for measuring technology?

The organizational structure of AFFDL satisfies the requirement for a set of basic technology activities. AFFDL is composed of five divisions with each division responsible for several exploratory development projects, each of which is subdivided into a set of tasks. The task is the smallest documented effort element of AFFDL that receives a defined budget and, therefore, it becomes the basic element of the optimization problem. The input to any task is dollars and manpower, and the output is the value of the attainment of its defined technological objective in a timely manner.

The value associated with a given task at a given time is dependent upon its support of officially defined Air Force Systems Command (AFSC) proposed systems or subsystems and technological objectives. The value of a task is also dependent upon the present state-of-the-art in its technical area and its predicted rate of progress. The total value of the AFFDL program is the sum of the values of its individual tasks. Because the budget is limited, it must be divided among the tasks in such a way as to maximize the total value of the AFFDL program.

The cost-effectiveness of a task is defined as the ratio of value received to money spent. Three choices of funding are possible for each task; (1) funds requested by task engineers, (2) funds necessary to perform the task with twice the requested manpower, and (3) no funds. Choices 1 and 2 are called resource

levels 1 and 2, respectively. The optimal allocation of funds is determined by first choosing the most cost-effective resource level for each task, then ranking all tasks according to cost-effectiveness, and, finally, funding tasks in order of decreasing cost-effectiveness until the budget is expended. This process is continued for five years with the state-of-the-art of each task at the beginning of each year depending upon the funding level for the preceding year. This process is shown in Figure 1.

The following reports are generated by the program:

- Input data listing
- Input error listing
- System support versus task matrix
- Adjusted system support versus task matrix
- Technological objective versus task matrix
- Limited war support versus task matrix
- 1498 associated work units, listed by task
- Cost-effectiveness ranking (Priority List) for each year
- Project summary for each year (Annual Report)
- Five year project summary (Final Report)
- List of tasks not selected for five years
- Technological objective and system support profiles
- Facility utilization report

Examples of the reports are presented in Section III.

The first seven reports are written prior to the optimization phase and therefore are not dependent upon the results of the task funding procedure. The limited war data and the 1498 associated work units are not used in calculations within the program. The facilities used by a given task are neglected in determining its cost-effectiveness. The facility utilization report is used as an aid in predicting the facility requirements generated by the optimal selection of the tasks.

The term "optimal selection" usually signifies a linear programming approach to solving the budget allocation problem. This problem can indeed be structured as a linear programming problem with the simplification, however,

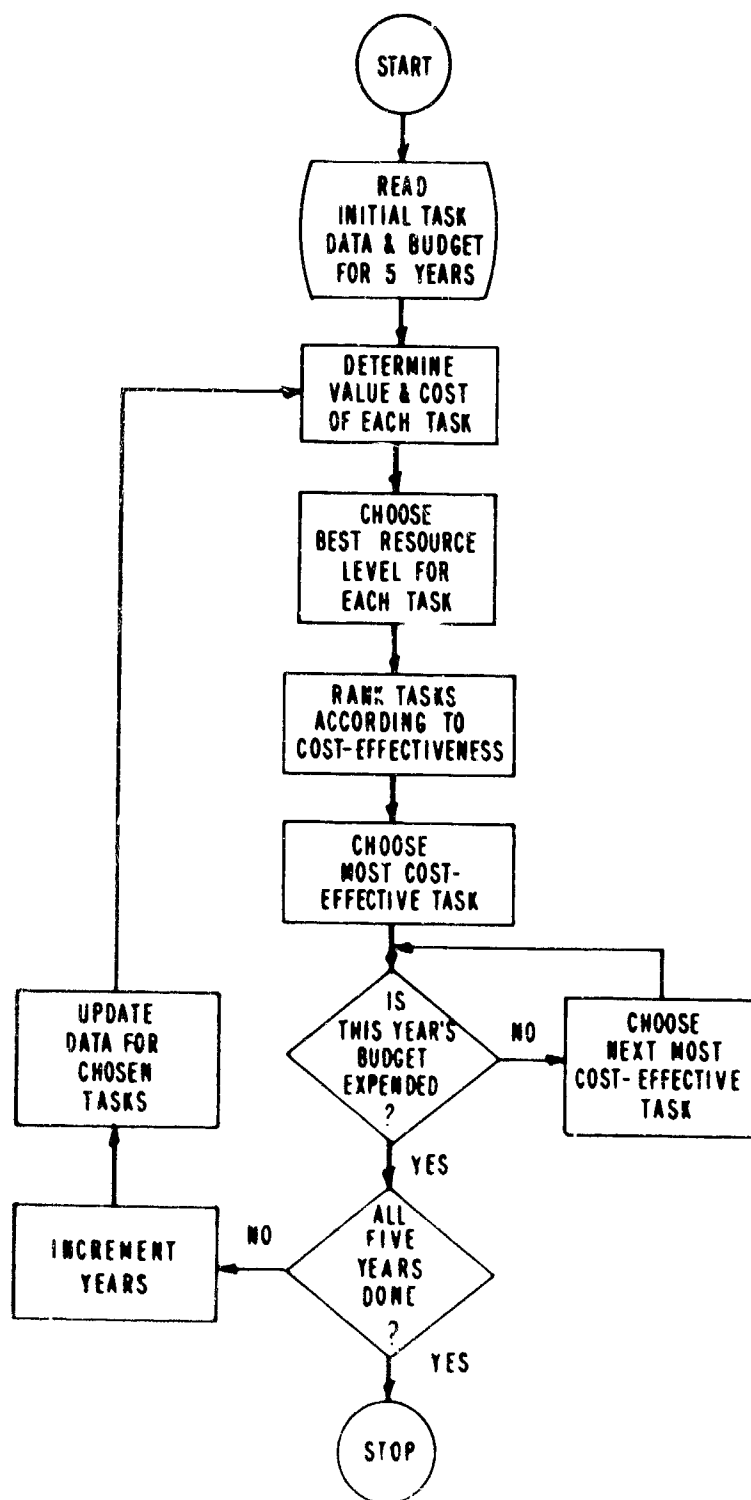


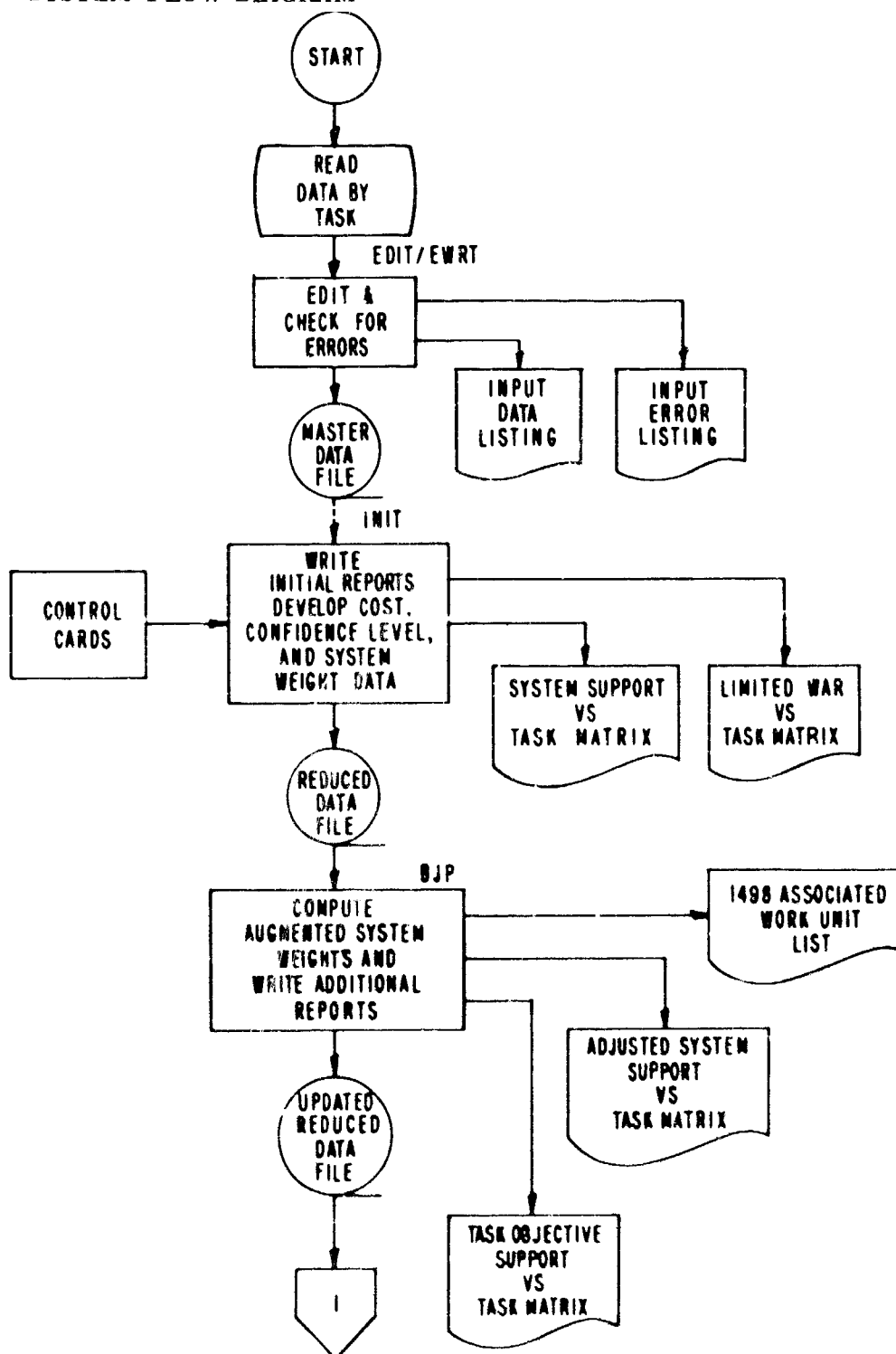
Figure 1. RDE Logic Flow Diagram

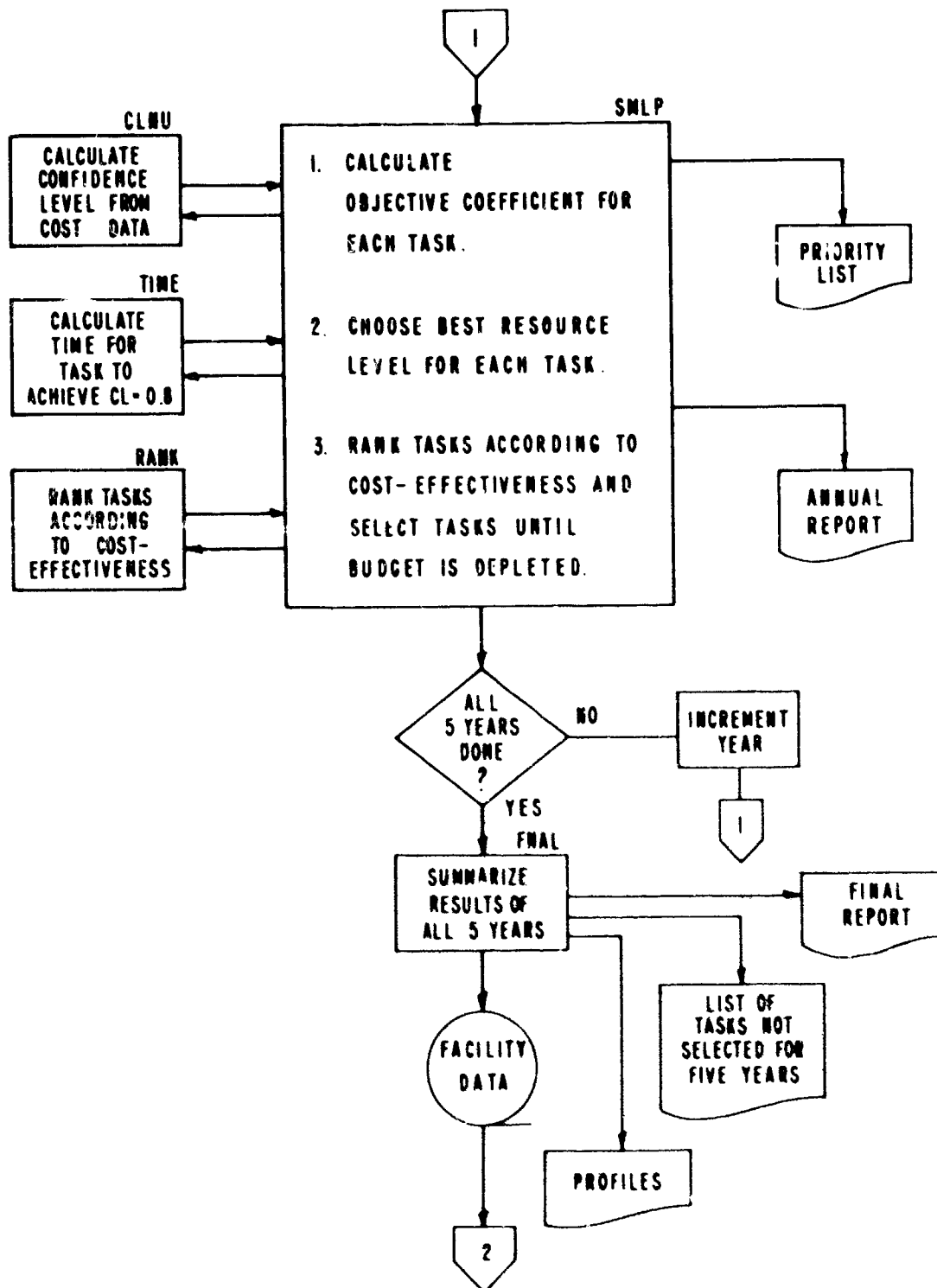
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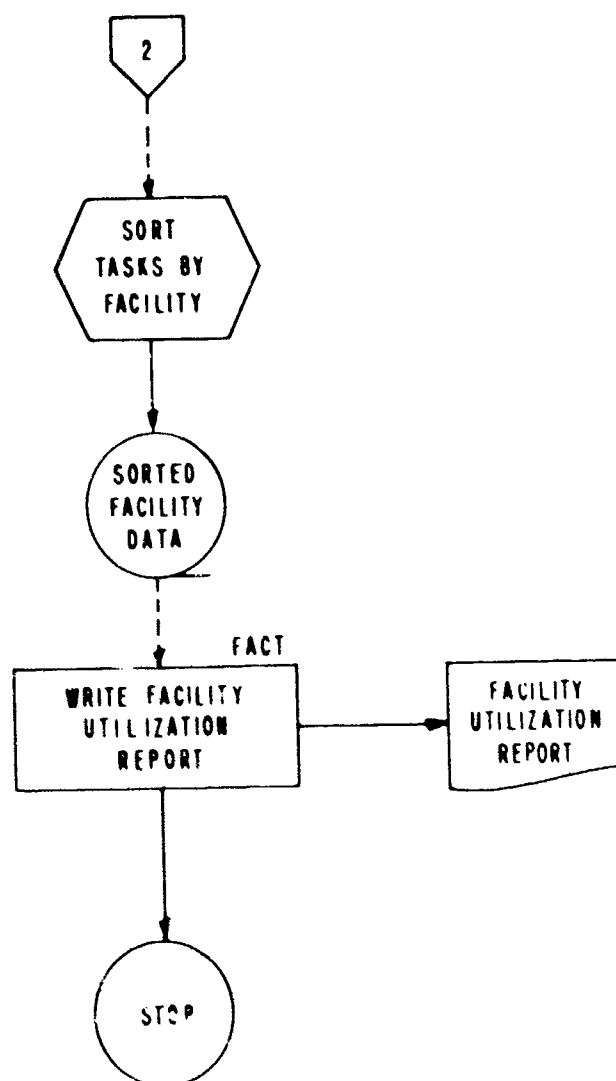
of having only one constraint, money. The existence of only one constraint eliminates the need for the commonly used Simplex algorithm and allows selections to be made on the criteria of highest ratio of objective coefficient (value) to row coefficient (cost).

Earlier versions of this program did employ the Simplex algorithm to solve the problem because exploratory development laboratory manpower was considered a constraint. This constraint, however, has been eliminated because of the realistic assumption that, if a manpower limit has been met before the laboratory's budget has been expended, the surplus funds can be used to employ more personnel.

3. SYSTEM FLOW DIAGRAM







4. DESCRIPTION OF ROUTINES

a. EDIT Routine

This routine reads in the following data for each task:

- Division number
- Project number
- Task number
- Subtask number
- Task engineer's name, office symbol, and telephone extension
- Project engineer's name
- Limited war support data including degree of support to limited war, special air warfare, interdiction, close air support, and logistics.
- Ranking of task within the division
- Task title
- Confidence levels achieved during preceding four years
- Contract and support funds used during preceding four years
- Contract and support funds requested for present year for both resource levels
- Contract engineers and in-house engineers requested for present year for both resource levels
- Identification number of each technological objective supported by this task and the percent of the total task effort that directly affects the completion of that technological objective
- Identification number of each system supported by this task and the percent of the total task effort that directly affects the progress of that system
- 1498 associated work units
- Amount of contract and support funds and engineering manpower necessary to achieve each confidence level
- Identification number of each facility used to achieve each confidence level and the required number of occupancy hours

Most of this data is not operated upon in EDIT since the primary purpose of this routine is to eliminate data input errors. In addition to making several sequence checks to assure that all the data for each task is in its proper order, the following error checks are made:

- Division number too large
- Division ranking exceeds number of tasks within the division (This requires that the number of tasks per division be available as part of the program)
- Confidence level less than .2 or greater than .8
- Illegal system identification number
- System support greater than 100%
- Illegal technological objective identification number
- Technological objective support greater than 100%
- Total engineers less than .3 for resource level one
- Total engineers for resource level two greater than double the total engineers for resource level one
- Total engineers for resource level two less than total engineers for resource level one
- Illegal facility code (This requires that a list of all facility codes be available as part of the program)
- Zero occupancy hours needed for a given facility
- Non-zero occupancy hours associated with no facility
- Confidence level data not given in steps of .1

Manipulation of the data only occurs when the confidence level of a task for 1968 is not an even tenth. The confidence level calculating routine CLNU requires the cost to go from one even tenth to the next largest even tenth. Therefore, in the case of a task not starting at an even tenth, the given data must be extrapolated in the following manner.

Let CLH(4) be the non-even tenth confidence level for 1968 and CAS be the contract plus support funds needed to achieve the next largest even-tenth confidence level CLA. Letting $[x]$ represent the largest integer $\leq x$, CLA is

equal to $.1 \left[10. \cdot CLH(4) \right] + .1$, and therefore the cost to go from $CLA - .1$ to CLA is $\frac{.1 \cdot CAS}{CLA - CLH(4)}$. The engineer data to go from $CLH(4)$ to CLA must also be multiplied by $\frac{.1}{CLA - CLH(4)}$ to determine the number of engineers needed to go from $CLA - .1$ to CLA .

b. EXEC Routine

The function of the executive routine is to:

1. Read in the budget constraints, number of years, and the logical variables which control report generation and resources level ceilings.
2. Perform necessary tape positioning functions.
3. Control iteration on multi-year passes.

c. INIT Routine

This routine reads in the edited input and writes out the limited war versus task matrix and the system support versus task matrix including the row averages. These averages are the sum of the system contributions for a given task divided by the number of systems supported by that task. The column totals and averages are also printed. The column total for a given system is the sum of the contributions for all tasks that support that system. The column average for a given system is the sum of the contributions divided by the number of tasks that support that system. These column averages are retained and become input to the BJP routine.

Since the only constraint to the optimization problem is money, all costs associated with a given task are adjusted to include the costs of the contract and in-house engineers. The equation used for this process is:

$$C_k = CS_k + CENG \cdot (EC_k + EI_k) \quad (1)$$

where

k is the resource level

CS_k is contract and support dollars

EC_k is contract engineers

EI_k is in-house engineers

and

CENG is the cost of employing one engineer for one year. This cost is currently set at \$12.7 (Note that all costs are expressed in thousands of dollars).

d. BJP Routine

The input for this routine is the edited task data and the average contribution for each system. The output is the 1498 associated work unit list, the adjusted system support versus task matrix, and the technological objective support versus task matrix including row averages.

The adjusted system contributions are determined by the following equation:

$$\text{if } b_j \leq \bar{b}_j, \quad b'_j = b_j \quad (2a)$$

$$\text{if } b_j > \bar{b}_j, \quad b'_j = b_j \left[1 + 2.5 (b_j - \bar{b}_j) \right] \quad (2b)$$

where

b_j is the original system contribution

b'_j is the adjusted system contribution

and

\bar{b}_j is the average system contribution for all tasks.

This adjustment has the effect of increasing the contributions to a system for those tasks whose support is greater than the average. In most cases the average contribution for a task is higher than its unadjusted average on the system support matrix; it cannot be lower.

e. SMLP Routine

SMLP, the "simulated linear programming" routine, is the central sub-program of the system. A thorough understanding of this routine is necessary

for the successful implementation of the RDE program. The major requirement of this program (solving for the optimal allocation of funds) can be described as a linear programming problem with the variables being the resource levels of the different tasks. The constraint equation of this problem is the inequality requiring that the sum of the costs of the selected tasks does not exceed the laboratory's budget; the objective function is the linear functional representing the sum of the values of the resource levels of each selected task. Since there is only one constraint equation, and since the variables can only be 1 or 0, representing funded or not funded, the iterative Simplex method of solving linear programming problems can be replaced by the more direct approach of considering the ratio of value to cost for each resource level of each task.

RDE_k , the value of resource level k for a given task, is determined by the following equation:

$$RDE_k = \frac{CL'_k - CL}{CL} (d \cdot B_k + T_k) \quad (3)$$

where CL is the present confidence level of the task

CL'_k is the confidence level achieved if the task is funded at RL_k

d is the ranking factor

B_k is the total system contribution

and T_k is the total technological objection contribution

The confidence level, CL , for the first year of a five-year problem is given as input data. The confidence level for each succeeding year remains at CL if the task is not selected, or becomes the CL'_k of the preceding year if resource level k is selected. The projected confidence level, CL'_k , is determined by linear interpolation of the cost versus confidence level function derived from the input data.

Let x_m represent a confidence level of $.1 \cdot m$ where $m = 2, \dots, 8$ and let z_m represent the cumulative cost to reach x_m starting at CL . Then if C_k , the

resource level k funds, is contained in the interval, $z_m < C_k \leq z_{m+1}$, the projected confidence level, CL'_k , can be determined by the following equation:

$$CL'_k = x_m + 0.1 \frac{C_k - z_m}{z_{m+1} - z_m} \quad (4a)$$

If, however, $C_k \leq z_m$ where $x_{m-1} \leq CL < x_m$, the following equation must be used:

$$CL'_k = CL + (x_m - CL) \frac{C_k}{z_m} \quad (4b)$$

The following input data will be used to determine a cost versus confidence level graph (Figure 2) and as sample data to clarify some of the equations.

		CONFIDENCE LEVEL	COSTS TO ACHIEVE
CL = .24	$C_1 = 13$	.3	10
		.4	0
	$C_2 = 25$	.5	20
		.6	20
		.7	0
		.8	5

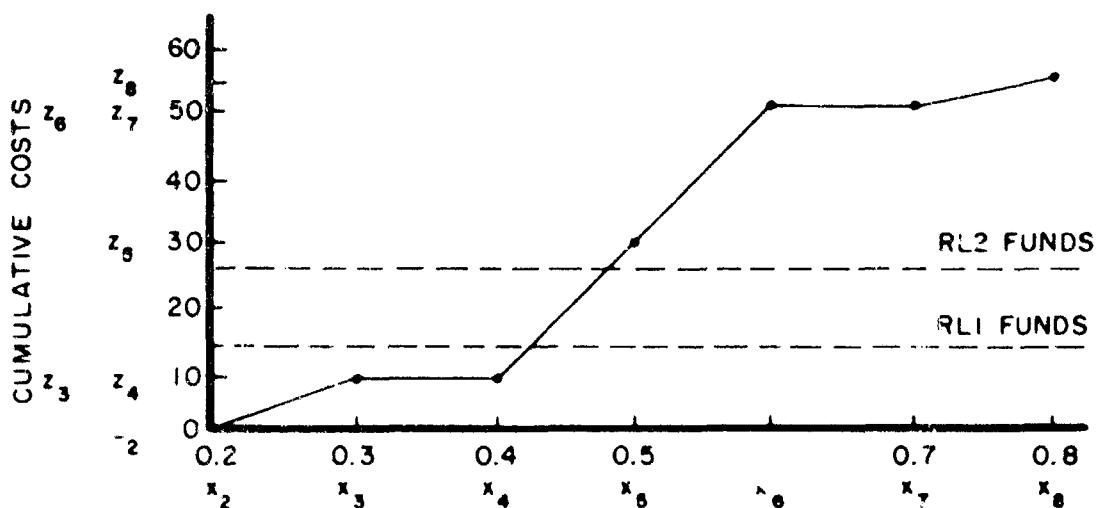


Figure 2. Cost versus Confidence Level Graph

Using the above sample data, CL'_1 for the first year can be calculated from (4a) as follows:

$$\begin{aligned} CL'_1 &= x_4 + 0.1 \times \frac{C_1 - z_4}{z_5 - z_4} = 0.4 + 0.1 \times \frac{13 - 10}{30 - 10} \\ &= 0.4 + 0.1 \times \frac{3}{20} = 0.415 = 0.41^* \end{aligned}$$

and if resource level 1 were selected for the first year, CL'_2 for the second year is:

$$\begin{aligned} CL'_2 &= x_5 + 0.1 \times \frac{C_2 - z_5}{z_6 - z_5} = 0.5 + 0.1 \times \frac{25 - 18}{38 - 18} \\ &= 0.535 = 0.53^* \end{aligned}$$

Note that $z_5 = \frac{.5 - .41}{.1} \times 20 = 18$ and $z_6 = z_5 + 20 = 38$

The ranking factor d is used to adjust the total system contribution of a task according to its relative importance with respect to the other tasks of that division. The equation for determining d is:

$$d = e^{-x^2} + 0.37 \quad (5)$$

where

$$x = \frac{R - 1}{D_n - 1}$$

$e = 2.71828 \dots$

R is the ranking of the task within the division

and D_n is the number of tasks in division n .

Note that d ranges from 1.37 for $R = 1$ (the most important task) to $\frac{1}{e} + .37 = .367 + .37 = .737$ for $R = D_n$ (the least important task).

The total system contribution, B_k , is calculated by the following equation:

$$B_k = \sum_j b'_j \cdot c_j \cdot T_{k,j} \quad (6)$$

where b'_j is the adjusted contribution of this task to system j
 c_j is the weight of system j as determined by AFFDL

* CL'_k is always truncated to the nearest hundredth because any smaller increment has no useful meaning.

and $T_{k,j}$ is the timeliness factor for resource level k with respect to system j .

$T_{k,j}$ is dependent upon the ratio of y_k to t_j where y_k is the number of years of resource level k funding required to reach a confidence level of .8 and t_j is the required progress rate from system j . Actually, t_j is the expected time-to-completion for system j as determined by Hq AFSC. The ratio $\frac{y_k}{t_j}$ then defines $T_{k,j}$ as follows:

$$\begin{aligned}
 \text{If } \frac{y_k}{t_j} \leq 0.5, \quad T_{k,j} &= 2 \cdot \frac{y_k}{t_j} \\
 \text{If } 0.5 < \frac{y_k}{t_j} \leq 1.5, \quad T_{k,j} &= 1 \\
 \text{If } 1.5 < \frac{y_k}{t_j} \leq 2.0, \quad T_{k,j} &= 4 - 2 \cdot \frac{y_k}{t_j} \\
 \text{If } 2.0 < \frac{y_k}{t_j}, \quad T_{k,j} &= 0
 \end{aligned} \tag{7}$$

This is shown graphically by Figure 3.

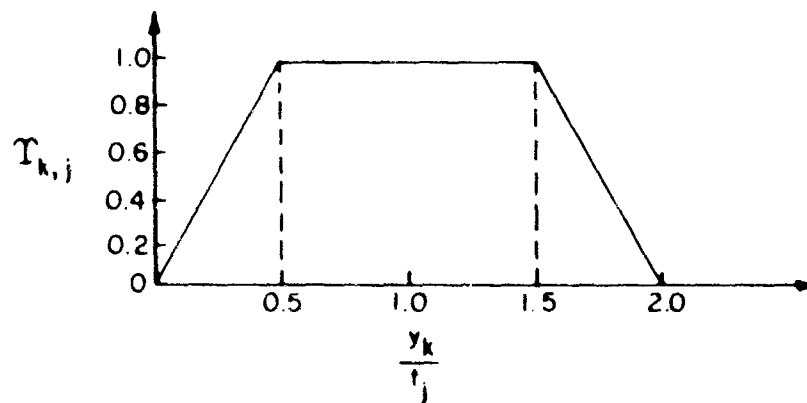


Figure 3. Timeliness Function Graph

The purpose of this function is to devalue those tasks which will be completed too early or too late to aid the development of the system. y_k is determined by first calculating the confidence level achieved when the task is funded at resource level k for the first year. If $CL'_k < 0.8$, CL becomes CL'_k and a new CL'_k is calculated by again funding the task at resource level k . This procedure continues until CL'_k exceeds 0.8. The number of years that are required to reach .8 in this manner is y_k . (Fractional years are considered whole years).

For example, using the data of Figure 2, y_1 and y_2 can be determined as follows:

YEAR	CL ₁	CL ₂
1969	.2	.2
1970	.41	.47
1971	.47	.59
1972	.53	.8+
1973	.59	
1974	.8+	

Therefore, $y_1 = 5$ and $y_2 = 3$.

Then, for $t_6 = 3$,
 $T_{1,6} = 4 - 2 \cdot \frac{5}{3} = \frac{2}{3}$ and
 $T_{2,6} = 1$.

The total technological objective contribution is calculated by the following equation:

$$T_k = \sum_j g_j \cdot h_j \cdot T_{k,j} \quad (8)$$

where g_j is the contribution of this task to technological objective j
 h_j is the weight of technological objective j as determined by AFFDL
and $T_{k,j}$ is the timeliness factor for resource level k with respect to technological objective j . $T_{k,j}$ is calculated in the same manner as the timeliness factor for systems. This requires that the progress rate for each technological objective be given.

After the two objective coefficients, RDE_1 and RDE_2 , have been calculated, the maximum ratio of $\frac{RDE_k}{C_k}$ is determined.* The resource level k giving this maximum is then the most cost-effective resource level for this task. After the most cost-effective resource level is determined for every task, the cost-effectiveness ratios are arranged in descending order. The tasks are then funded in this order until the entire laboratory budget is expended. If, after r tasks are funded, the cost of the $(r + 1)$ st task is greater than the remaining budget, the $(r + 1)$ st task is not funded.** The confidence levels of the funded tasks are updated to the CL'_k associated with the selected resource level. After the selections

* If $CL'_k > .8$, C_k becomes $10 \cdot (.8 - CL) \cdot C_k$.

** It is possible to continue to search the list for a task whose required funds are less than the remaining budget. This is not done by this routine and therefore the above set of selections is not truly optimal unless, of course, no task can be found in the remaining list whose required funds are less than the remaining budget.

are made and confidence levels updated, this routine writes out the Priority List and the project summary (Annual Report) for the year being considered.

f. FNAL Routine

This routine is used if more than one year is being optimized. It is entered after the budgets for all years have been optimally allocated. The results of these optimizations and the edited input is used to construct a history of each task for the time period under consideration. A maximum time period of five years is allowed. Any task not selected during this time period is added to the list of "tasks not selected for any year." This routine also writes the system and technological objective profiles. These profiles show the progress of those tasks that support each system or technological objective at a level $\geq .7$.

As the final report for each task is being written, the facility-utilization input data is interrogated to determine the number of facility occupancy hours used by each task during each year. A task is charged for using a facility during the year it reaches the confidence level associated with that facility. If the confidence level of a task is increased by more than .1 during a year, the number of facility occupancy hours used is the sum of the hours associated with the confidence level gained. This is illustrated by the following sample case. If the input data for a task includes:

CL	FACILITY CODE	OCCUPANCY HOURS	FACILITY CODE	OCCUPANCY HOURS
.3	1000	15	2000	24
.4	3000	30	3005	12
.5	3000	15		
.6	2000	40	3005	24
.7	1000	120	2000	50
.8	2000	20	3000	12

and if the task history is:

1968	1969	1970	1971	1972	1973
.28	.40	.46	.52	.73	.76

then the facility utilization is:

FACILITY CODE	1969	1970	1971	1972	1973
1000	15	0	0	120	0
2000	24	0	0	90	0
3000	30	0	15	0	0
3005	12	0	0	24	0

g. FACT Routine

The main function of this routine is to match the facility codes with the facility titles and to determine the total yearly usage of each facility. The input to this routine is the sorted facility data from FNAL and the list of all facility titles. The output is the facility utilization report.

5. APPLICATIONS AND LIMITATIONS

This program, as written, is constrained to the structure of AFFDL; hence emphasis has been on a consistent and well-defined program structure. Obviously, most organizations will not have five divisions and their hierarchal arrangement will be more or less than the three levels (division, project, task) assumed by this program. This type of organizational difference, however, is not too critical since the determination of the value coefficient (except for the AR factor) and the allocation of funds are not affected by the organizational structure. It is, therefore, possible for an organization with more or less than five divisions to redefine these divisions to give exactly five distinct groups. This may not always be desirable, but when it is, it eliminates the time and effort needed to modify the program. Likewise, if the organization has more than three hierarchal levels, it may be possible to define a task in a manner that includes more than one lower level. AFFDL accomplishes this by defining more than one subtask for the same task.

The system and technological objective contribution terms of the value coefficient may seem to be Air Force dependent. There is no reason, however, to preclude these being used to represent items such as company goals or products

manufactured. As an example, for an activity representing the development of a very efficient distillation process for a chemical company, the g_j terms could represent the contribution of this process to the manufacturing of each of the company's products and the h_j terms could represent the importance of each of these products to the overall company development.

A possible future revision is the increase of the number of resource levels. Programming-wise, it is a minor change and could be implemented within a few days. The added resource levels would result from interpolating the linear function derived from the two points RL1 and RL2, i. e., RL1.1 resources would be RL1 resources plus .1 of the resources between RL1 and RL2. The advantage of having additional resource levels would be an increase in the completed overall effectiveness of the lab and a more flexible funding approach for each task. The disadvantage, however, of this approach lies in the assumption that the function formed by the two resource levels is linear and not step-wise continuous as is probably the case. Related to this disadvantage is the task engineer's confusion and lack of confidence in the program caused by his being asked to perform his activity at a budgetary and manpower level that he had not presented to the program. Our experience has shown that better task engineer cooperation has been achieved by keeping the number of funding levels at a minimum and, therefore the alternative of additional resource levels has not, as yet, been implemented.

The "facility-utilization" data in no way affects the optimal allocation of resources. This may not be a realistic assumption, and, particularly if a facility is being used beyond its capacity, it may be desirable to constrain its use. One method of doing this would be the non-funding of tasks using this facility once its capacity is met, assuming, that funding is done by ranking on the priority list. This would eliminate over-usage but would result in a suboptimal allocation since the linear-programming problem would now have two constraints, thereby requiring an iterative L. P. solver. If the disadvantage of using a large L. P. algorithm is more attractive than the disadvantage of exceeding facility capacities, it is then suggested that all facility constraints be considered in the L. P. program and activities representing the construction of new facilities be added.

The program as written will only optimize for up to five years. This limit of five years may be increased indefinitely since the iterative process is independent

of the number of years to be optimized. The only modifications required in the program would be to change the storage allocation of some of the variables and to revise the FINAL REPORT, FACILITY REPORT, and the PROFILES. Before the decision to increase the number of years is made, however, it must be noted that any allocation beyond the first year is suboptimal since it does not consider those tasks that may originate during the following year. Particularly, during the later years, it is possible to have an excess of funds since many tasks may have already reached .8 in preceding years. One solution to this problem is to have the budget decrease by a given percent each year. This is equivalent to assuming that each year the newly proposed tasks will require a given percentage of the budget. It should also be noted that the overall effectiveness of the laboratory for five years is larger when all five years are considered simultaneously than when each year is considered separately, even though the effectiveness of individual years may be lower. The problem of considering all five years simultaneously is quite complicated, however, and would again require a large-scale L.P. solver.

If it is desirable to negate the influence of the AR factor in the objective coefficient, the easiest approach would be to use the same AR number for every task. If, however, modifications have to be made to the program, the easiest solution would be to eliminate the AR factor from the value coefficient equation. The value coefficient also contains the term $\frac{1}{CL}$. This dividing of the value coefficient by the present confidence level has the effect of heavily weighting those tasks with low confidence levels. This is done to emphasize starting tasks over tasks nearing completion and is consistent with the philosophy of the Air Force Flight Dynamics Laboratory. If, however, this emphasis is not desirable, the $\frac{1}{CL}$ term should be deleted from the value coefficient equation.

The assumption of constant resource level funds and manpower for all five years leads to somewhat biased results in favor of those tasks which have rather constant resource requirements to reach each confidence level. In particular, those tasks which require very little funds to reach all but one confidence level and large funds to achieve the remaining confidence level may never get selected. This is caused by their RL1 and RL2 funds not being adequate for them to reach .8 in time to get credit for the systems and technological objectives supported.

The director of this type of task may also be embarrassed by being selected at a resource level for one year which (from his cost versus confidence level function) indicates that he should be able to increase his confidence level by up to .4 when, in fact, other nonmonetary constraints exist that limit his progress to an increase of at most .1. A possible future revision to the program that may solve this problem is for the engineer to replace his RL2 data by the maximum confidence level he can achieve each year. RL2 could then be the resources needed to reach this given confidence level.

When this program is used for the first time, there may be a tendency for the task engineer, or his equivalent if a different organization structure exists, to "beat the system" to assure funding. This can easily be done by overestimating the progress attainable from his requested resources. This manipulation of the data can be discouraged by careful examination by the engineer's supervisor and by reference to the historical data. An interesting addition to the program could be the identification of those tasks whose predicted progress is inconsistent with their historical data.

SECTION III

INPUT-OUTPUT DESCRIPTION

1. INPUT FORMAT

The input form is shown in Figure 4. There is a maximum of 12 cards per task. Columns 1 - 8 of every card contains the variable ITASK; column 78 of every card is blank; and columns 79 - 80 of every card contains the card sequence number.

Each card will be described separately with the descriptors in the MODE column defined as 'I' for integer, 'R' for real number, and 'A' for alphanumeric data. All real numbers must either contain a decimal point or be right-justified if a decimal point is not used. All monetary input is in thousands of dollars. Card 1 contains:

<u>COLUMN</u>	<u>VARIABLE</u>	<u>MODE</u>	<u>DESCRIPTION</u>
1 - 8	ITASK	I	Task number, must be integer $\geq 100,000$
9 - 29	NAMT (1, ..., 4)	A	Task engineer's name, preferably with last name first.
30	IDIV	I	Division number, must be ≤ 5 , checked by EDIT
31 - 35	ISYM	A	Office symbol
36 - 40	LEXT	A	Telephone extension
41 - 64	NAMP (1, ..., 4)	A	Project engineer's name, again with last name first
65 - 66	LIM(1)	A	Percent of task's effort supporting limited war
67 - 68	LIM(2)	A	Percent of task's effort supporting special air warfare
69 - 70	LIM(3)	A	Indicator denoting a significant contribution to the Air Force's performance of its classical role of interdiction. 'XX' indicates contribution; blank indicates no contribution

<u>COLUMN</u>	<u>VARIABLE</u>	<u>MODE</u>	<u>DESCRIPTION</u>
71 - 72	LIM(4)	A	'XX' or blank, denoting contribution to close air support
73 - 74	LIM(5)	A	'XX' or blank, denoting contribution to logistics
75			Blank
76 - 77	AR	R	Rank of task within division. "1" represents the most important task. EDIT checks the rank to assure that it does not exceed the number of tasks within its division.
78			Blank
79 - 80	IC	I	'01' representing the first card for this task. Checked by EDIT.
<u>Card 2 contains:</u>			
9 - 54	ITITLE (1,...,8)	A	Task title containing up to 46 characters
55 - 59			Blank
66 - 63	CS(1)	R	Contract plus support funds requested at RL1 for 1969
64 - 67	CS(2)	R	Contract plus support funds requested at RL2 for 1969
68 - 69			Blank
70 - 72	CLH(1)	R	Confidence level of this task at end of FY 1965 (must be < .8)
73			Blank
74 - 77	CSH(1)	R	Contract plus support funds used in 1965
78			Blank
79 - 80	IC	I	'(2'

<u>COLUMN</u>	<u>VARIABLE</u>	<u>MODE</u>	<u>DESCRIPTION</u>
<u>Card 3 contains:</u>			
9			Blank
10 - 54	IT (1, ..., 15)	I	Identification numbers of technological objectives supported by this task. Use three columns for each T.O. Use leading zeroes. Example: 7 should be written as 007
55 - 59			Blank
60 - 63	EC(1)	R	Contract engineers requested at RL1 for FY 1969
64 - 67	EC(2)	R	Contract engineers requested at RL2 for FY 1969
68 - 69			Blank
70 - 72	CLH(2)	R	Confidence level of this task at end of FY 1969
73			Blank
74 - 77	CSH(2)	R	Contract plus support funds used in FY 1969
78			Blank
79 - 80	IC	I	'03'
<u>Card 4 contains:</u>			
9			Blank
10 - 54	T (1, ..., 15)	R	Percent of task's effort that supports the T.O.'s directly above these columns. Use three columns for each T.O. supported. Entry must contain decimal point and be ≤ 1 .
55 - 59			Blank
60 - 63	EI(1)	R	In-house engineers requested at RL1 for FY 1969

<u>COLUMN</u>	<u>VARIABLE</u>	<u>MODE</u>	<u>DESCRIPTION</u>
64 - 67	EI(2)	R	In-house engineers requested at RL2 for FY 1969
68 - 69			Blank
70 - 72	CLH(3)	R	Confidence level of this task at end of FY 1967
73			Blank
74 - 77	CSH(3)	R	Contract plus support funds used in FY 1967
78			Blank
79 - 80	IC	I	'04'

Card 5 contains:

9			Blank
10 - 39	IS (1, ..., 15)	I	Identification numbers of all systems supported by this task. Use two columns for each system. Use leading zeroes.
40 - 69			Blank
70 - 72	CLH(4)	R	Confidence level of this task at end of FY 1968
73			Blank
74 - 77	CSH(4)	R	Contract plus support funds used in FY 1968
78			Blank
79 - 80	IC	I	'05'

Card 6 contains:

9			Blank
10 - 39	S (1, ..., 15)	R	Percent of task's effort that supports the systems directly above these columns. Use two columns for each system supported. Entry must contain decimal point and be less than 1.

<u>COLUMN</u>	<u>VARIABLE</u>	<u>MODE</u>	<u>DESCRIPTION</u>
40 - 69	RWU (1,...,10)	I	1498 related work units. Use three columns per unit. Use leading zeroes
70 - 78			Blank
79 - 80	IC	I	'06'
<u>Card 7 contains:</u>			
9			Blank
10 - 11	CL	R	Base confidence level of the confidence level versus cost curve. It is the first even tenth greater than CLH (4). Column 10 must contain a decimal point. $.3 \leq CL \leq .8$
12 - 16	CAS	R	Contract plus support funds necessary to reach CL from CLH (4)
17 - 21	ENC	R	Contract engineers needed to reach CL from CLH (4)
22 - 26	ENI	R	In-house engineers needed to reach CL from CLH (4)
27 - 30	IFAC (1)	I	Identification number of one of the facilities needed to reach CL from CLH (4)
31 - 34	OCC (1)	R	Number of hours of use of facility IFAC (1) needed to reach CL from CLH (4). Fractional hours not considered.
35 - 42	IFAC(2), OCC(2)	I, R	Same as 27 - 34
43 - 50	IFAC(3), OCC(3)	I, R	Same as 27 - 34
51 - 58	IFAC(4), OCC(4)	I, R	Same as 27 - 34
59 - 66	IFAC(5), OCC(5)	I, R	Same as 27 - 34
67 - 74	IFAC(6), OCC(6)	I, R	Same as 27 - 34
75 - 78			Blank
79 - 80	IC	I	'07'

Cards 8 - 12 have the same format as card 7 with the exception that CL now is the previous CL + .1 and all the resources (CAS, ENC, ENI) and facilities represent the requirements of going from the previous CL to the present CL. If CL is .8, no more cards should follow for this task.

The set of up to twelve cards per task is read into the EDIT routine. This data must be preceded by a card containing, in columns 1 through 5, the total number of tasks. This number is used as a check to guarantee that the data for all tasks has been read in. A maximum of 250 tasks may be considered. The output from EDIT is the master file which is input to the INIT routine. The following two control cards are required as input to the EXEC routine (refer to System Flow Diagram, Section 1.3). Card 1 contains:

<u>COLUMN</u>	<u>VARIABLE</u>	<u>MODE</u>	<u>DESCRIPTION</u>
1 - 5	DOFAC	L*	'T' if facility report is to be written. 'F' otherwise.
6 - 10	DOREP	L	'T' if the system support matrix, the adjusted system support matrix, the technological objective matrix, the limited war matrix, and 1498 associated work unit list are to be written.
11 - 15	DOPRO	L	'T' if technological objective and system profiles are to be written
16 - 20	DORLI	L	'T' if resource level 1 can only be used
21 - 25	DORL2	L	'T' if resource level 2 can only be used

Card 2 contains:

1 - 5	LASTY	I	Number of years to run program. Must be ≤ 5
6 - 15	BUDG(1)	R	First year budget
16 - 25	BUDG(2)	R	Second year budget
26 - 35	BUDG(3)	R	Third year budget
36 - 45	BUDG(4)	R	Fourth year budget
46 - 55	BUDG(5)	R	Fifth year budget

* L denotes logical variable

[illegible]

Figure 4. Sample Input Form

2. PROGRAM CONSTANTS

The following information, although in data statements within the program, is peculiar to the Air Force Flight Dynamics Laboratory and, therefore, should be considered as input data. The defining routines for this data are in parentheses.

- List of valid facility codes (EDIT)
- Number of tasks within each division (EDIT, INIT)
- Specified times-to-completion for systems and technological objectives (BLOCK DATA)
- Designated weights of systems and technological objectives (BJP)
- Cost of one engineer for one year (BLOCK DATA)
- Project titles (BLOCK DATA)
- Division titles (SMLP)
- Facility grouping titles (FACT)

In addition to the above information, the titles for each facility are read in by the FACT routine under an (I4, 9A6, A2) format. Columns 1 - 4 of each card contain the facility code and columns 5 - 60 contain the facility title.

15 APR 68

ROE FY 1969 INPUT DATA

LIMITED WAR DATA
LW SW IN CS LG
.3 .3 XX XX XX

AR 27

ASSESSMENT OF STRUCTURAL RESPONSE

CIVILIAN	TASK	TITLE
1	13470260	

7 A 5A

SUPPORT OF SYSTEMS

STUDY OF TECH. DES.

[illegible]

TO	0C1	0C2	004	005	007	008	009	C10	C14	01
SUB	.9	.9	.0	.0	.9	.9	.9	.9	.9	.9

01 120 061 00

0002 003 005 006 007 008 009 010
ASSOCIATED 1498 WORK UNITS

RY - 69	CS	ENG	ENG
100.0	0.6	3.0	
325.0	1.2	7.0	

CL	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
0.20	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
0.30	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10
0.40	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20
0.50	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30
0.60	0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40
0.70	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50
0.80	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50	1.60
0.90	0.90	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70
1.00	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80

FACILITY CODE	OCC COURS	FACILITY CODE	OCC HOURS
0000	0000	0000	0000

FACILITY	UTILIZATION
CC	FACILITY OCC
CCS	CODE
	HOLDS

	CL VS.	RESOURCE DATA	FACILITY OCC	FACILITY CODE
CL	CS	EMGC EMGHC	FACILITY CODE	FACILITY CODE

[illegible]

100.0	0.3	4.1
100.0	0.3	4.1
100.0	0.3	4.1

LIMITED WAR DATA
LW SW IN CS LG
.3 .3 XX XX XX

AR 16

STATISTICAL TESTING CONTINUED

SUPPLY OF SYSTEMS

SUPPORT OF TECH OBJS

SYS	C5	09	10	11	12	13	14	
SUP	.7	.7	.8	.7	.8	.5	.5	

1C 001 002 000 010 013 014 015 016 017 018 019 020 021 022 023 024 025 026 027 028 029 030 031 032 033 034 035 036 037 038 039 040 041 042 043 044 045 046 047 048 049 050 051 052 053 054 055 056 057 058 059 060 061 062 063 064 065 066 067 068 069 070 071 072 073 074 075 076 077 078 079 080 081 082 083 084 085 086 087 088 089 090 091 092 093 094 095 096 097 098 099 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 10

71 100 00

	ASSOCIATED	1498	WORK	UNITS
005	007	009	001	012 013

FY - 65	CS	ENG	RESOURCES
100.0	0.3	6.0	
100.0	0.6	12.0	

	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
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FACILITY CODE	CCC HOURS	FACILITY CODE	CCC HOURS
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0044	0044	0044	0044
0045	0045	0045	0045
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0084	0084	0084	0084
0085	0085	0085	

FACILITY	UTILIZATION
CC	FACILITY CCC
LRS	CCOE HCLRS

CL	VS.	RESOURCE DATA	FACILITY	OCC	FACILITY CODE
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CL VS. RESOURCE DATA
CL CS ENGCS ENGLH

Figure 5. Input Data Listing

TASK	VERSUS TASK MATRIX										15 APR 68	
	ROE 1969	BJ	SYSTEMS							AVERAGE	16	ACROSS
			9	10	11	12	13	14	15			
13470200	.6	.6	.6	.6	.6	.9	.6	.5	.5	.655		
13470300	.7	.6	.7	.8	.7	.8	.5	.5	.5	.671		
13470400	.6	.6	.6	.6	.6	.9	.6	.6	.6	.630		
13670200	.7	.7	.7	.7	.7	.7	.7	.7	.7	.700		
13670201	.7	.7	.7	.7	.7	.7	.7	.7	.7	.700		
13671100	.5	.5	.5	.5	.5	.5	.5	.5	.5	.500		
13671400	.5	.5	.5	.5	.5	.5	.5	.5	.5	.500		
13671500	.7	.7	.7	.7	.7	.7	.7	.7	.7	.700		
13671600	.3	.3	.3	.3	.3	.3	.3	.3	.3	.300		
13671700	.5	.5	.5	.5	.5	.5	.5	.5	.5	.500		
13671701	.1	.1	.1	.1	.1	.1	.1	.1	.1	.100		
13680200	.5	.5	.5	.5	.5	.5	.5	.5	.5	.500		
13680301	.5	.5	.5	.5	.5	.5	.5	.5	.5	.500		
13680302	.5	.5	.5	.5	.5	.5	.5	.5	.5	.500		
13680406	.5	.5	.5	.5	.5	.5	.5	.5	.5	.500		
13680500	.4	.4	.4	.4	.4	.4	.4	.4	.4	.400		
13680700	.4	.4	.4	.4	.4	.4	.4	.4	.4	.400		
13680900	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		
13681001	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		
13681002	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		
13681200	.7	.7	.7	.7	.7	.7	.7	.7	.7	.700		
13681300	.7	.7	.7	.7	.7	.7	.7	.7	.7	.700		
13681401	.7	.7	.7	.7	.7	.7	.7	.7	.7	.700		
13681403	.7	.7	.7	.7	.7	.7	.7	.7	.7	.700		
13681502	.4	.4	.4	.4	.4	.4	.4	.4	.4	.400		
14670100	.4	.4	.4	.4	.4	.4	.4	.4	.4	.400		
14670200	.5	.5	.5	.5	.5	.5	.5	.5	.5	.500		
14670300	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		
14670400	.7	.7	.7	.7	.7	.7	.7	.7	.7	.700		
14670500	.7	.7	.7	.7	.7	.7	.7	.7	.7	.700		
13660200	.7	.7	.7	.7	.7	.7	.7	.7	.7	.700		
13660300	.7	.7	.7	.7	.7	.7	.7	.7	.7	.700		
13660500	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		
13660600	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		
13660700	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		
13660800	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		
13660900	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		
13661000	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		
13661201	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		
13661202	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		
13661203	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		
13661300	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		
13661601	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		
13661602	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		
13661701	.7	.7	.7	.7	.7	.7	.7	.7	.7	.700		
13661702	.7	.7	.7	.7	.7	.7	.7	.7	.7	.700		
13661704	.7	.7	.7	.7	.7	.7	.7	.7	.7	.700		
13661705	.4	.4	.4	.4	.4	.4	.4	.4	.4	.400		
13661800	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		
14260100	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		
14260106	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		
14260300	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		
14260500	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		
14261000	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		
14261100	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		
14261200	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		
14310200	.6	.6	.6	.6	.6	.6	.6	.6	.6	.600		

Figure 6. Sample System Support versus Task Matrix

TASK	ROE 1969										VERSUS TASK MATRIX										AVERAGE ACROSS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16					
1472200	0.				0.6	0.7	0.7	0.7	0.6	1.2	0.6	1.6	0.6	0.5	0.	0.	0.8109				
1473100	0.				0.8	0.7	0.7	0.7	0.9	1.2	0.9	1.2	0.5	0.5	0.	0.	0.8753				
1473600	0.				0.6	0.7	0.7	0.7	0.6	0.6	0.6	1.6	0.6	0.6	0.	0.	0.7316				
1474200	0.				0.9	0.9	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.9083				
1475000	0.				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.	0.	0.8930				
1475100	0.				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.	0.	0.5000				
1475400	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.8924				
1475500	0.				0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1475800	0.				0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.4429				
1475900	0.				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.	0.	0.3000				
1476100	0.				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.	0.	0.5753				
1476200	0.				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.	0.	0.5000				
1476300	0.				0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.	0.	0.9023				
1476400	0.				0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.5	0.4	0.	0.	0.5909				
1476500	0.				0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.	0.	0.4000				
1476600	0.				0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.	0.	0.5599				
1476700	0.				0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.	0.	0.8303				
1476800	0.				0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.	0.	0.8303				
1476900	0.				0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.	0.	0.9006				
1477000	0.				0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.	0.	0.9046				
1477100	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.8907				
1477200	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.8907				
1477300	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.8135				
1477400	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.4402				
1477500	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.6181				
1477600	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.7375				
1477700	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.7234				
1477800	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.9884				
1477900	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.7313				
1478000	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.5897				
1478100	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.7181				
1478200	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.9023				
1478300	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.7277				
1478400	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.7391				
1478500	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.6560				
1478600	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.4000				
1478700	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.6229				
1478800	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.6171				
1478900	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.4000				
1479000	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.6129				
1479100	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	1.4064				
1479200	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	1.4052				
1479300	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.5933				
1479400	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.8602				
1479500	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.7520				
1479600	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.5141				
1479700	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.8540				
1479800	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.5419				
1479900	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1480000	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1480100	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.6234				
1480200	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1480300	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1480400	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1480500	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1480600	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1480700	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1480800	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1480900	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1481000	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1481100	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1481200	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1481300	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1481400	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1481500	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1481600	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1481700	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1481800	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1481900	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1482000	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1482100	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1482200	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1482300	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1482400	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1482500	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1482600	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1482700	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1482800	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1482900	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1483000	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1483100	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1483200	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1483300	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1483400	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1483500	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1483600	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1483700	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1483800	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1483900	0.				0.5	0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9	0.9	0.	0.	0.3000				
1484000	0.																				

Figure 7. Sample Adjusted System Support versus Task Matrix

TECH OBJS

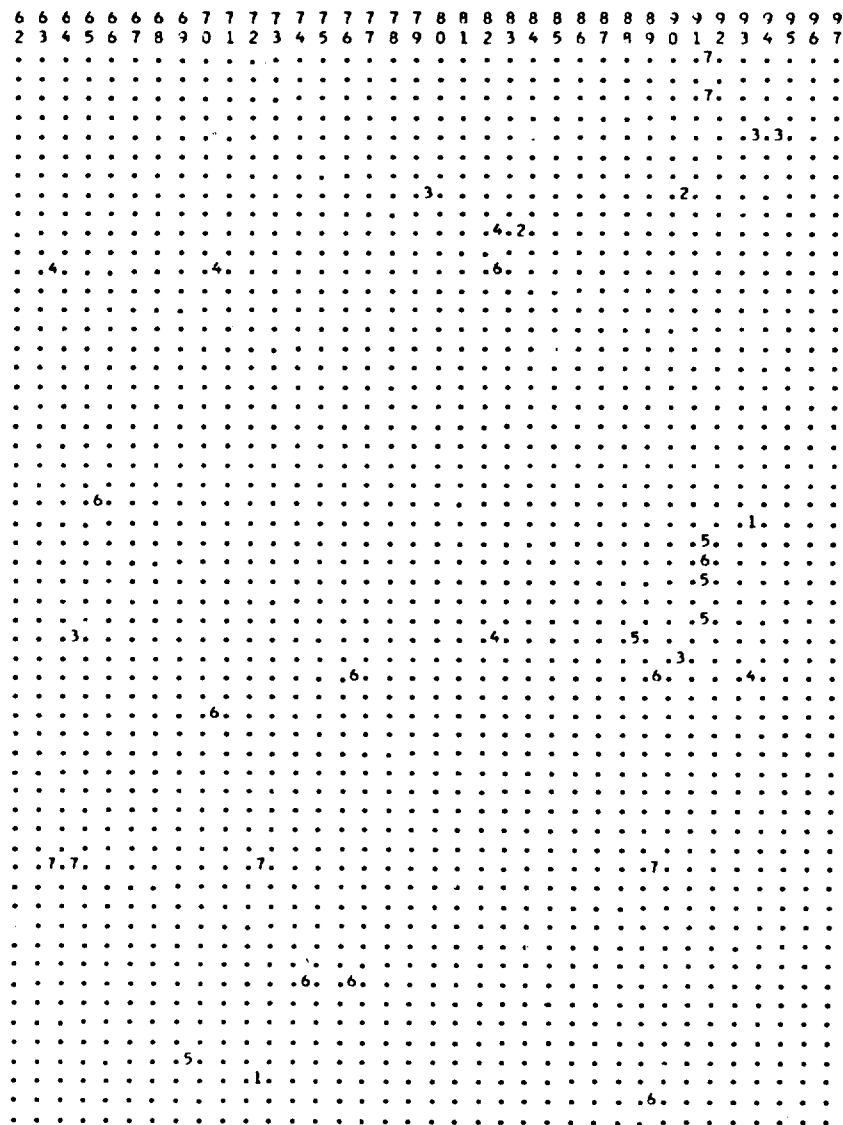
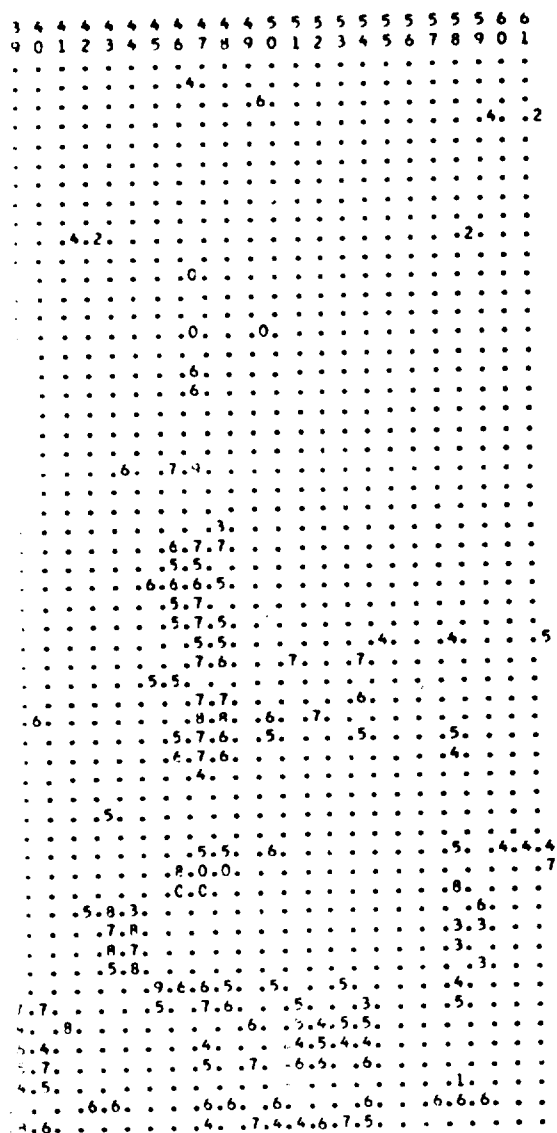


Figure 8. Sample Technological Objective Support versus Task Matrix

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TASK	ASSOCIATED 1498 WORK UNITS									
13470200	002	003	005	006	007	008	009	010		
13470300	005	007	009	001	012	013				
13470400	002	003	005	006						
13670200	003									
13670201	001	007	009	010						
13671100										
13671400	001									
13671500										
13671600										
13671700										
13671701										
13680200	001	002								
13680301										
13680302										
13680400	005									
13680600	003	004	005							
13680700	002	001								
13680900	001									
13681001	001	002								
13681002	001	002								
13681200	001									
13681300	001									
13681401										
13681403										
13681502										
14670100	002	003	004	005						
14670200	008	009	010	011	012					
14670300	005	006	007	008						
14670400	006	008	004	009						
14670500	003	005	008	009						
13660200	002	003								
13660300	001	004	005							
13660600	003									
13660700	001	003	010	012	013	016	017	018		
13660800	002	006	007	008						
13660900	001	003	005	006						
13661000	001									
13661201	006	007								
13661202										
13661203										
13661300	005	007	008	009	011	012				
13661601	009	010	011	012	013					
13661602	008	011	2	013						
13661701										
13661702	004									
13661704										
13661705	001									
13661800										
14260100	001	002								
14260300										
14260400	004	005	006	008	009	010				
14260800	001	006								
14261000	001	002	003	004	005	006	007	008	009	010
14261100										
14261200	003	004	005	006	007	008	010	011		
14310200										
14310300	001									
14310700	004									
14310900	001	002								

Figure 13. Sample 1498 Associated Work Units List

PRIORITY LIST FOR 1969										16 APR 68	
RANK	TASK	TITLE	RL	C+S	ENCC	ENGIN	OBJ	RATIO	CUM C+S	CUM DRJ	CUM COST
1	13691403	COMBAT DAMAGES AND LOSSES DATA ANALYSIS	1	1	0	0.5	3.151	.02379	0.	3.151	6.3
2	82130902	AIR CUSHION LOING GEAR SYS FOR ARSPEE VEHICLES	1	1	0	0.3	3.279	.02372	0.	3.230	12.2
3	13671701	MODEL DITCHING TESTS	1	1	0	0.6	3.342	.01943	0.	3.572	27.8
4	14762022	INTEGRATED AIRFRAME NOZZLE TESTING TECHNIQUES	1	1	0	0.3	3.081	.01877	11.0	3.653	32.6
5	82223303	ROTATING INSURERS	2	2	0	0.5	2.861	.03863	211.0	3.926	246.6
6	82223301	LOW COST RESOLVERS	2	2	0	0.1	1.212	.00765	361.0	3.989	404.9
7	82223301	AUTOMATIC TERRAIN FOLLOWING	2	2	0	0.6	3.054	.00703	361.0	3.989	412.5
8	82190703	AUTOMATIC GUST RESPONSE	2	2	0	0.6	3.284	.00583	561.0	5.264	632.9
9	13623303	AERODYNAMIC PROPERTIES OF NOSE CAPSULE	2	2	0	1.4	3.94	.03228	561.0	5.358	650.7
10	82250803	MULTI-PARAMETER SELF-ORGANIZING CONTROL	2	2	0	0.3	3.040	.00521	561.0	5.397	658.3
11	13693301	COMPOSITE CONSTRUCTION FOR FLIGHT VEHICLES	2	2	0	0.7	3.183	.00488	591.0	5.581	695.9
12	13652200	PERFORMANCE ANALYSIS OF FLIGHT VEHICLES	2	2	0	0.7	3.628	.00456	716.0	5.209	833.6
13	82193701	VISUAL STABILITY AND CONTROL PREDICTION METHODS	2	2	0	0.8	3.821	.00443	876.0	7.030	1019.0
14	14250102	VISIBILITY FOR HYPERSONIC AND REENTRY VEHICLES	2	2	0	0.7	3.422	.00391	966.0	7.432	1121.7
15	13660900	HIGH SPEED AERODYNAMIC ANALYSIS METHODS	1	1	0	0.3	3.520	.00363	1091.0	7.931	1259.4
16	13690700	AIR CUSHION LOING GEAR SYS FOR ARSPEE VEHICLES	2	2	0	0.3	3.331	.00337	1187.3	8.263	1357.6
17	14312700	APPLICATIONS ANALYSIS OF ADVANCED VEHICLE CONCEPTS	2	2	0	1.7	3.423	.00337	1287.3	8.685	1483.0
18	82223302	PULSED X-RAY POWER SUPPLY	1	1	0	0.4	3.260	.00324	1362.3	8.946	1563.4
19	13661602	SYNTHESIS OF HYPERSONIC VEHICLE POWERED	2	2	0	1.5	3.211	.00324	1492.3	9.156	1628.8
20	14260300	MAGNETO GASDYNAMIC TECHNIQUES	1	1	0	0.3	3.338	.00314	1502.3	9.495	1736.4
21	82262103	TACTICAL WEAPON DELIVERY	1	1	0	0.3	3.512	.00312	1502.3	9.507	1740.2
22	13693403	VIBRATION ACOUSTIC EQUIVALENCE	2	2	0	0.7	3.285	.00307	1582.3	9.791	1832.9
23	82251102	SOLID STATE ELECTRICAL MULTIPLEX SYSTEM	2	2	0	0.6	3.635	.00306	1772.3	10.397	2030.5
24	13671700	MANEUVER LOADS PROGRAMS	2	2	0	1.6	3.229	.00304	1822.3	13.626	2105.9
25	13631502	INTEGRAL STRUCTURAL ARMOR	2	2	0	0.4	3.655	.00301	2022.3	11.281	2323.7
26	82251101	FLY-BY-WIRE	2	2	0	0.5	3.287	.00283	2114.5	11.568	2425.3
27	13705602	PREVENTION OF FLIGHT INDUCED DYNAMIC LOAD PROBLEMS	2	2	0	1.6	3.794	.00280	2364.5	12.362	2708.3
28	13693403	EXPANDABLE TIRES AND NEW TIRE CONCEPTS	1	1	0	0.3	3.510	.00272	2468.5	12.672	2827.5
29	13693403	AIRCRAFT STRUCTURAL VULNERABILITY	1	1	0	0.5	3.419	.00265	2515.4	12.821	2878.8
30	82273705	VISUAL FLIGHT TEST TECHNOLOGY	2	2	0	1.2	3.556	.00252	2715.4	13.377	3099.1
31	13673300	STRUCTURAL TESTING CRITERIA	1	1	0	3.2	3.238	.00248	2768.8	13.615	3195.3
32	82191101	FLIGHT CONTROL OPTIMIZATION TECHNIQUES	2	2	0	0.6	3.522	.00246	2968.8	14.138	3408.0
33	82222901	SOFT FLM TECH APPLIED TO INERTIAL SENSORS	1	1	0	0.1	3.528	.00235	3018.8	14.266	3462.6
34	13661300	LOW SPEED AERODYNAMIC ANALYSIS METHODS	2	2	0	0.5	3.411	.00234	3168.8	14.677	3638.0
35	13150200	LOW BEARING DESIGNS	2	2	0	1.4	3.156	.00222	3218.8	14.832	3708.3
36	82221002	MONOPULSE FLIGHT REFERENCE TECHNIQUE	2	2	0	0.6	3.517	.00219	3218.8	14.849	3715.9
37	13622304	ALLOY MECHANICAL PROPERTIES OF EJECTION SEATS	2	2	0	1.8	3.650	.00219	3218.8	15.271	3911.7
38	14673400	STRUCTURAL FATIGUE ANALYSIS	2	2	0	1.3	3.372	.00215	3368.8	15.743	4132.0
39	14712201	1-T AND FAN VOISE	2	2	0	1.0	3.472	.00214	3568.8	15.743	4132.0
40	82651202	1-KITILE PARACHUTE SIMILARITY LAWS	2	2	0	1.4	3.093	.00210	3592.8	15.836	4176.3
41	13681300	DISPERSION STRENGTHENED METAL STRUCTURES	2	2	0	1.2	3.777	.00207	3942.8	16.613	4551.7
42	13090801	ACCELERATED ENVIRONMENTAL TEST METHODS	2	2	0	0.3	3.347	.00207	4059.8	16.960	4719.5
43	14252101	AEROSPACE VEHICLE CRW STATION CRITERIA	2	2	0	0.6	3.324	.00199	4209.8	17.284	4882.2
44	14673500	CUMPUTERIZED STRUCTURAL ANALYSIS METHODS	2	2	0	1.5	3.458	.00194	4389.8	17.692	5092.7
45	13663600	HYPERSONIC BOUNDARY LAYER PROPERTIES	2	2	0	0.6	3.311	.00191	4539.8	18.003	5255.4
46	14673200	THERMOELASTIC STRUCTURAL ANALYSIS	2	2	0	1.6	3.411	.00176	4739.8	18.413	5488.4
47	14722400	INITIALIZATION OF DYNAMICS DATA	2	2	0	1.0	3.541	.00172	4859.8	18.655	5628.7
48	14252101	PASSIVE DEFENSE FOR PERSONNEL PROTECTION	2	2	0	0.6	3.319	.00170	5009.8	18.976	5816.8
49	14712203	HEAD-UP DISPLAY DEVELOPMENT	2	2	0	2.2	3.419	.00168	5084.8	19.117	5902.0
50	61912203	HEAD-UP DISPLAY DEVELOPMENT	2	2	0	0.6	3.443	.00168	5084.8	19.380	6059.6
51	13671400	STRUCTURAL LOAD CRITERIA SIMULATION TECHNIQUES	2	2	0	0.4	3.587	.00166	5234.8	19.380	6059.6
52	82260102	MULTIPLE FEEDBACK FOR LATERAL-DIRECTIONAL CONTROL	2	2	0	0.4	3.587	.00166	5234.8	19.380	6059.6
53	13660800	AERODYNAMIC CHARACTERISTICS OF HIGH SPD CONFIGURATIONS	2	2	0	0.6	3.514	.00161	5531.4	19.881	6369.8
54	14310900	TRAJECTORY AND MOTION ANALYSIS OF FLT VEHICLES	2	2	0	1.5	3.358	.00159	5731.4	20.239	6595.2
55	13661602	INVESTIGATION OF JOINTS CUTOUTS DESIGN CONCEPTS	2	2	0	0.4	3.657	.00157	5731.4	20.320	6666.0
56	14312203	PRELIMINARY VEHICLE SYNTHESIS	1	1	0	0.2	3.557	.00157	6131.4	20.977	7063.7
57	13671200	MEASUREMENT OF STRUCTURAL RESPONSE	1	1	0	0.3	3.556	.00155	6131.4	20.982	7067.0
58	13154400	WING PIVOT HEATINGS	1	1	0	0.6	3.254	.00151	6231.4	21.218	7223.4
59	82221203	INTEGRATED DATA SYSTEM-SIGNAL FORMAT	2	2	0	1.2	3.556	.00149	6381.4	21.471	7393.8
60	14702104	4-CIPROGATING CYRO REFRIGERATORS	2	2	0	0.4	3.458	.00148	6681.4	21.929	7703.9
61	82221303	HIGH Z HIGH TEMPERATURE SEMICONDUCTOR	1	1	0	0.3	3.327	.00146	6856.4	22.256	7927.2
62	51451700	SPACECRAFT THERMAL CONTROL	2	2	0	0.3	3.137	.00144	6947.2	22.363	8001.8
63	13622401	HIGH SLIM RATES ESCAPE CAPABILITY	2	2	0	2.1	3.537	.00143	7317.2	22.469	8076.1
64	13653100	LOW DENSITY VISCOUS GASDYNAMICS	2	2	0	0.9	3.537	.00143	7317.2	23.000	8445.4
65	61912203	VISUAL FLIGHT DIRECTOR COMPUTER DEVELOPMENT	2	2	0	0.5	3.152	.00135	7417.2	23.153	8559.1
66	13693403	AIRCRAFT STRUCTURAL VULNERABILITY	2	2	0	0.2	3.445	.00135	7517.2	23.298	8666.7

TRACTORS		DIVISION		ANNUAL OUTPUT 1969			16 APR 68		
PROJECT NAME		SUB-TOTAL TESTING OF FLIGHT VEHICLES		CL 69	CL 69	OBJ	U+S	KEAPLY V E	54580
TASK		TITLE						ENG	ENGIN
NONSEL	0200	MEASUREMENT ON STRUCTURAL RESPONSE		.50	.50	0.2352	100.00	0.60	3.80
NONSEL	0300	STRUCTURAL TESTING CRITE		.50	.50	0.2383	53.44	0.16	3.21
NONSEL	0400	THERMAL ASSESSMENT AND CONTROL		.50	.50	0.2901	135.00	0.50	7.50
				P400	TOTAL	0.	0.	0.	

Figure 12. Sample Annual Report

STRUCTURES		DIVISION	ANNUAL OUTPUT		STRUCTURAL TESTING OF FLIGHT VEHICLES		CLEARNEY V E		54680	BEST	OVERALL
PROJECT :347			CL 68	CL 69	OBJ	C+S	ENGE	ENGIN	RL	RANK	
TASK	TITLE										
NONSEL	MEASUREMENT OF STRUCTURAL RESPONSE		.50	.50	2.2352	100.00	0.60	3.80	1	57	
NONSEL	STRUCTURAL TESTING CRITERIA		.60	.60	2.2383	53.44	0.10	3.21	1	31	
NONSEL	HEAT THERMAL APPLICATION AND CONTROL		.50	.50	2.2901	135.00	0.50	7.50	2	73	
			PROJ	TOTAL	2.	2.	2.	0.			

16 APR 68

16 APR 68

Figure 12. Sample Annual Report

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Figure 13. Sample Final Report

16 APR 68

FY 1969 PROFILES

SYS SUPPORT 5

TASK	SUP	TITLE	CONFIDENCE LEVEL
13470303	5.7	STRUCTURAL TESTING CRITERIA	8
13672202	5.7	AEROSPACE VEHICLE LOADS CRITERIA	8
13672301	5.7	AEROSPACE VEHICLE LOADS CRITERIA	8
13671502	5.7	AIRLOADS AND LOADS DISTRIBUTION	8
13681401	5.7	AIRCRAFT STRUCTURAL VULNERABILITY	8
13681403	5.7	COMBAT DAMAGES AND LOSSES DATA ANALYSIS	8
14670402	5.7	STRUCTURAL FATIGUE ANALYSIS	8
14670502	5.7	COMPUTERIZED STRUCTURAL ANALYSIS METHODS	8
15665203	5.7	PERFORMANCE ANALYSIS OF FLIGHT VEHICLES	8
14761201	5.7	ANALYSIS OF INTAKE AND EXHAUST NOZZLE PERFORMANCE	8
14763301	5.7	INVESTIGATION OF AIRFRAME INLET INTERACTION	8
14763302	5.7	EXPERIMENTAL INTEGRATED AIRFRAME NOZZLE PERFORMANCE	8
61901103	5.7	VISTOL FLIGHT DIRECTOR COMPUTER DEVELOPMENT	8
82190103	5.7	AERODYNAMIC EFFECTS ON STABILITY AND CONTROL	8
82190203	5.7	STABILITY AND CONTROL ANALYSIS AND CONTROL	8
82190204	5.7	AERODYNAMIC CONTROLS	8
82190205	5.7	STRUCTURAL STABILITY AND CONTROL CHARACTERISTICS	8
82190403	5.7	FLIGHT CONTROL SYSTEMS ANALYSIS	8
82190501	5.7	HANDLING QUALITIES REQUIREMENT ESTABLISHED	8
82190502	5.7	HANDLING QUALITIES INVESTIGATION NEW	8
82221201	5.7	LOW COST FLIGHT RESEARCH STABILIZATION SYSTEM	8
82221202	5.7	ADVANCED DATA SYSTEMS FOR LOW NO HIGH SPD AIRCRAFT	8
82220301	5.7	LOW COST RESOLVERS	8
82221202	5.7	SOLID STATE AIR DATA COMPUTER	8
82221203	5.7	INTEGRATED DATA SYSTEM-SIGNAL FORMAT	8
82240601	5.7	STORABLE ENERGY MANAGEMENT TECHNOLOGY	8
82240602	5.7	PROPELLANT MASS GAGING	8
82240603	5.7	PROPELLANT FLOW RATE MEASUREMENT	8
82250803	5.7	DIRECT LIFT CONTROL	8
82250803	5.7	MULTI-PARAMETER SELF-ORGANIZING CONTROL	8
82251002	5.7	CATPL ACTUATOR TECH/INTGRD SRVD ACTATR PKAGE	8
82251101	5.7	FLY-BY-WIRE	8
82251102	5.7	SOLID STATE ELECTRICAL MULTIPLEX SYSTEM	8
82251103	5.7	MULTIPLEXED FLIGHT CONTROL SYSTEM	8
82260102	5.7	MULTIPLE FEEDBACK FOR LATERAL-DIRECTIONAL CTRL	8
82260103	5.7	TACTICAL WEAPON DELIVERY	8
13700301	5.7	UNSTEADY AERO METHODS DEVELOPMENT AND VERIFICATION	8
13700303	5.7	ORTHOGONAL ELASTIC INSTABILITY PREDICTION AND CRITERIA	8
13700303	5.7	PREDICTION AND CONTROL OF STRUCTURAL VIBRATION	8
13700301	5.7	PREDICTION AND CONTROL OF STRUCTURAL VIBRATION	8
13700302	5.7	PREDICTION AND CONTROL OF STRUCTURAL VIBRATION	8
14710102	5.7	ACQUSTIC FATIGUE	8
14710201	5.7	JET AND CAN NOISE	8
44371103	5.7	SONIC FACILITY DEVELOPMENT	8
44371103	5.7	NOISE SOURCE DEVELOPMENT	8
13090401	5.7	ACCELERATED ENVIRONMENTAL TEST METHODS	8
13090403	5.7	COMBINED ENVIRONMENTAL TEST TECHNIQUES	8
13090403	5.7	SHOCK TECHNOLOGY	8
13150402	5.7	WING PIVOT BEARINGS	8
13690102	5.7	LIGHT WEIGHT LANDING GEAR	8
14700104	5.7	RECIPIRATING CRYO REFRIGERATORS	8
14700203	5.7	CRYOGENIC BEARINGS AND SEALS	8
60652906	5.7	AIRCRAFT RESCUE CAPABILITY	8
61461403	5.7	OXYGEN CONCENTRATION AND SUPPLY	8
61461503	5.7	AIRCRAFT THERMAL CONTROL	8

Figure 14. Sample System Profile

16 APR 68

AFFOL-EXISTING FACILITIES ROE 1969 FACILITY UTILIZATION REPORT

		69	HOURS - BY FISCAL YEAR		73
			70	71	
0100	WIND TUNNEL, HYPERSONIC (GAS-DYNAMIC - 50 MW)				
136616C1	SIFRON T. DECAMP R. 55006		0	0	0
	TOTAL HOURS		0	0	0
0200	WIND TUNNEL, HYPERSONIC (GAS-DYNAMIC - 4 MW)				
136603C3	SIFRON T. DECAMP R. 52630		0	100	0
136618C2	SIFRON T. DECAMP R. 55006		0	0	0
142609C0	HILLMANER V. E. 53061		0	0	0
	TOTAL HOURS		0	100	0
0300	WIND TUNNEL, SUPERSONIC (GAS-DYNAMIC - 2 FT)				
136616C2	SIFRON T. HURNETT U. 55006		50	0	0
	TOTAL HOURS		50	0	0
0400	WIND TUNNEL, HYPERSONIC (GAS-DYNAMIC - PEBBLE BED)				
136603C3	MCCLDERY EDWIN 52630		0	120	0
136607C2	NEUMANN RICHARD D. 52701		0	0	0
136608C0	MARTINEZ GUADALUPE JR. 52630		0	0	120
136609C0	DAWLEY VALENTINE 52630		240	0	0
136616C1	SIFRON T. DECAMP R. 55006		0	0	0
	TOTAL HOURS		240	120	120
0500	STRUCTURES TEST FACILITY (AEROSPACE VEHICLES)				
134702C0	FRANKOW D. N. 54680		0	0	300
134703C0	JOHNSTON W. M. 54680		4080	0	0
134704C0	NEALE ROBERT A. 55067		0	0	700
136813C0	RANNEY C. 55349		0	300	0
146702C0	MADDUX GENE L. 55689		0	0	500
146704C0	MCNO HOWARD A. 55689		0	2500	0
	TOTAL HOURS		4080	2800	1500
0501	INDUCTIVE HEATING (RF) FACILITY				
134704C0	NEALE ROBERT A. 52067		0	0	400
	TOTAL HOURS		0	0	400
0502	STRUCTURES TEST SENSOR DEVELOPMENT FACILITY				
134702C0	FRANKOW D. N. 54680		0	0	300
	TOTAL HOURS		0	0	300
0600	ENVIRONMENTAL RESEARCH LABORATORY				
134704C0	NEALE ROBERT A. 52067		0	0	300
	TOTAL HOURS		0	0	300

Figure 15. Sample Facility Utilization Report

SECTION IV

PROGRAMMING GUIDE

1. RUNNING THE PROGRAM

The following diagrams are included to facilitate proper setup of the program decks. The edit program is run first, and must execute with no error messages before a master file is built.

Following the successful completion of EDIT, the entire RDE program can be run in one pass. General instructions to the operator should be to mount the master file on logical 1, and scratch tapes on logical 7, 8, and 11. Note that 2 data cards precede the 90 sort control cards, and that the Facility titles are entered as data following the FACT routine.

2. PROGRAMMING NOTES

As with any program, certain peculiarities arise within the code that can cause not only different results when running check cases, but also can cause program hangup. This section is supposed to resolve some of these difficulties.

1. To preclude the difficulties encountered with INTEGER type statements, all variables are implicitly typed. In addition, integer names are used for alphanumeric data.

2. If a variable is used in more than one routine, its Fortran name will always be the same in all the routines and COMMON statements.

3. The I-Format on this compiler allows left justified integers which do not necessarily fill the field. This fact is reflected in the way the input forms are designed.

4. EXEC calls a routine DATE, which, again on this system, returns in 2 words the day, month, and year. It is suggested that, if this feature is not available, a function DATE could be written which would read in this information. The date is printed on each report so that the user can always determine which is the latest production run.

EDIT

CARD

ARRANGEMENT

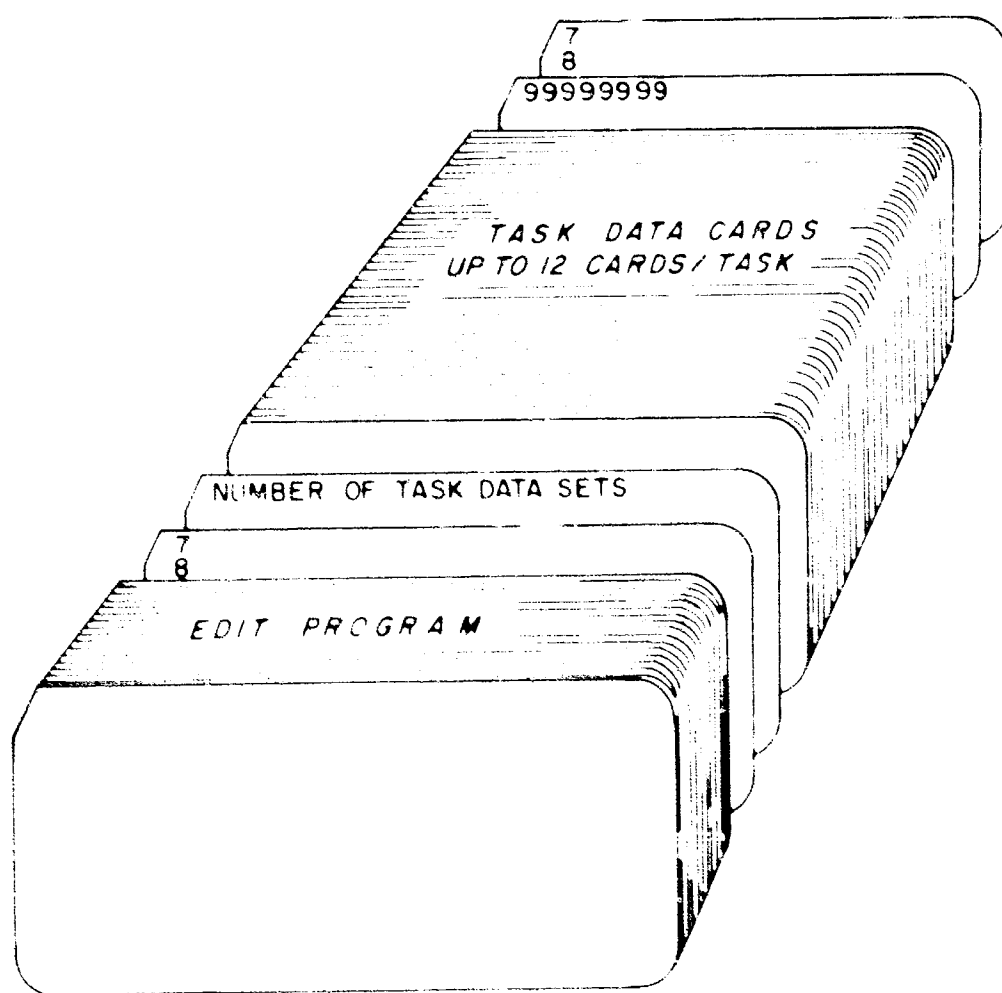


Figure 16. EDIT Deck Setup

RDE

CARD

ARRANGEMENT

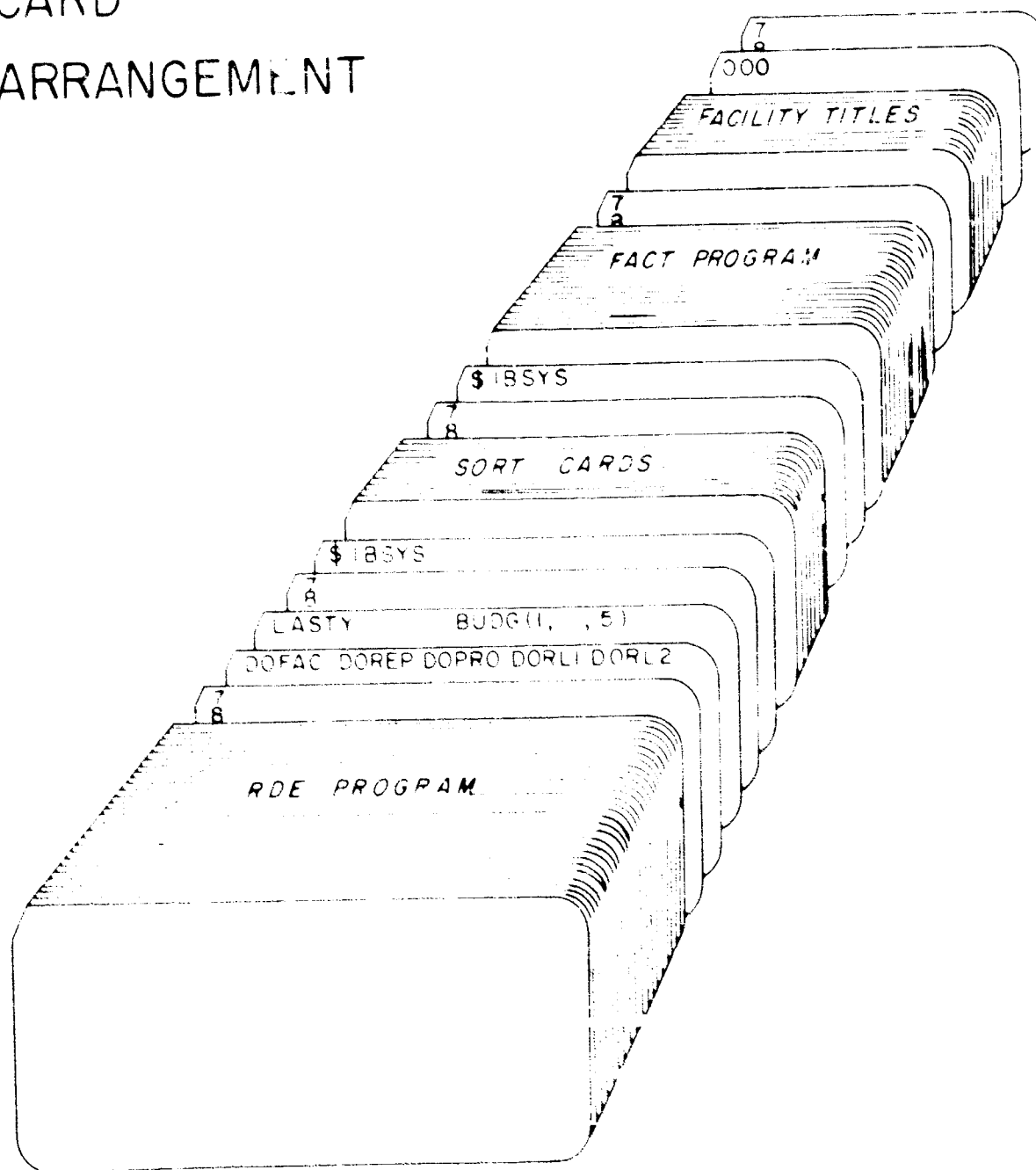


Figure 17. RDE69 Deck Setup

5. In many cases small numbers are added to computed quantities. This is to circumvent certain round off problems which developed during the debug phases of the program, and have nothing to do with the formulation.

6. Once the input data tape has been generated by EDIT, the rest of the programs run as a system. Between the final report routine and the facility listing program, there is a 7090 Sort, to arrange the facility data in its proper order. Subroutine FINAL writes a series of records for each task which uses facilities, each record pertaining to the utilization of a facility. The tasks being processed are in ascending order. The purpose of the 7090 Sort pass is to sort the records by facility, the tasks then being in ascending order by facility. It is this order the FACT routine requires to produce its report. As a matter of interest, the record to be sorted has the following construction:

WORD	DESCRIPTION
1	IOCS generated
2	Facility code
3	Task number
4 - 7	Task engineer's name
8	Task engineer's telephone extension
9 - 13	Facility utilization by year

7. The size of the dimensions of all variables both in COMMON and in DIMENSION are the same in all routines in which they appear.

8. The program is designed to run on a 7040/7090 Direct Coupled System, where 7090 has only core to core communication with the 7040. The 7040 in turn handles all the I/O equipment including tape and pseudo tape data areas in the 1301 disk file.

Minimal configuration for a stand-alone 7090 with no disk would be 4 tapes: 1 for input, 2 for scratch files (preferably on different channels), and 1 for output. This is excluding normal input and output units, and systems and library files. The sort configuration will be a function of the order of merge desired.

9. Running times are extremely variable when using the DCS, but a rough approximation will be given. The values are based on about 250 tasks being processed for 5 years.

	7090 Time	Lines Output
EDIT	1 MIN	4000
RDE	6 MIN	15000
SORT	1 MIN	300*
FACT	1 MIN	3500

* Number of records sorted

EDIT.

C	RTN TO PRE-EDIT RCE INPUT DATA	A	2
C	COMMON /ED/ ERROR,IC,ICT(2),ITASK	A	3
	DIMENSION CAS(8),CLH(4),CSH(4),CS(2),DUM(15),EC(2),EI(2),ENC(8),	A	4
1	ENI(9),IAR(5),IFAC(6,8),IALF(5),IS(15),IT(15),ITITLE(8),	A	5
2	LF(6,80),LIM(5),NAMP(4),NAMT(4),OCC(6,8),RMU(10),S(15),	A	6
3	T(15),TS(15),TT(15)	A	7
	LOGICAL ERROR,HCR	A	8
	DATA NSY,NTG,HCR/14,116,T/	A	9
	DATA (IALF(1),I=1,5)/1H1,1H2,1H3,1H4,1H5/	A	10
	DATA (LF(1,1),I=1,80)/	A	11
1	0100,0101,0200,0300,0400,0500,0501,0502,0503,0504,	A	12
2	0600,0601,0602,0700,0701,0800,0900,0901,0902,0903,	A	13
3	0904,59*0/	A	14
	DATA (LF(2,1),I=1,80)/	A	15
1	1000,1100,1200,1300,1400,1401,1500,1501,1700,1800,	A	16
2	1900,1901,1902,1903,1904,65*0/	A	17
	DATA (LF(3,1),I=1,80)/ 80*0/	A	18
	DATA (LF(4,1),I=1,80)/	A	19
1	3001,3002,3003,3004,3005,3006,3007,3008,3009,	A	20
2	3010,3011,3012,68*0/	A	21
	DATA (LF(5,1),I=1,80)/	A	22
1	4001,4002,4003,4004,4005,4006,4007,4008,4009,4010,	A	23
2	4011,4012,68*0/	A	24
	DATA (LF(6,1),I=1,80)/	A	25
1	5010,5011,5012,5013,5020,5021,5022,5030,5040,5041,	A	26
2	5050,5051,5052,5053,5054,5055,5056,5057,5058,5059,	A	27
3	5060,5061,5062,5063,5090,5091,5092,5093,5100,5110,5111,5120,	A	28
4	5130,5131,5132,5140,5141,5150,5160,5170,5180,5190,5200,	A	29
5	5210,5211,5220,5230,5231,5232,5233,5234,5235,5236,5237,	A	30
6	5238,5239,5240,5241,5242,5300,5301,5400,5401,17*0/	A	31
	DATA (IAR(1),I=1,5)/ 30,35,67,19,37/	A	32
C		A	33
C	BEGIN EDIT. BRING IN TASK COUNT	A	34
C		A	35
	READ (5,390) NT	A	36
	CALL DATE (ICT)	A	37
	IDP=0	A	38
	ERROR=.FALSE.	A	39
	IK=0	A	40
C		A	41
C	READ FIRST CC.	A	42
C		A	43
100	READ (5,390) ITASK,NAMT,IDIV,(SYM,LEXT,NAMP,LIM,AR,IC	A	44
	ITAT=ITASK	A	45
	IF (ITAT.LE.999999) ITAT=ITAT*100	A	46
	IF (ITASK.EC.99999999) GO TO 280	A	47
	IK=IK+1	A	48
	IF (IDIV.NE.IDP) GO TO 110	A	49
C		A	50
C	CHECK FOR ASCENDING TASK SEQUENCE	A	51
C		A	52
	IF (ITAT.LT.ITP) CALL EMRT (14)	A	53
	GO TO 120	A	54
110	ICP=IDIV	A	55
		A	56

EDIT.

120	ITP=ITAT	A	57
	IF (IC.EQ.1) GO TO 130	A	58
	CALL EWRT (1)	A	59
	GO TO 100	A	60
C		A	61
C	CHANGE IDIV FROM ALFA TO INTEGER	A	62
C		A	63
130	DO 140 I=1,5	A	64
C		A	65
C	CHECK FOR PROPER DIV. NR	A	66
C		A	67
	IF (IDIV.EQ.IALF(1)) GO TO 150	A	68
140	CONTINUE	A	69
	CALL EWRT (2)	A	70
150	IDIV=I	A	71
C	CHECK FOR AR FACTOR IN RANGE	A	72
	IR=AR+.0001	A	73
	IF (IR.GT.IAR(IDIV)) CALL EWRT (3)	A	74
C		A	75
C	READ SECOND CD.	A	76
C		A	77
	READ (5,400) ITK,ITITLE,CS,CLH(1),CSH(1),IC	A	78
	IF (IC.NE.2) GO TO 100	A	79
	IF (ITK.NE.ITASK) CALL EWRT (4)	A	80
C		A	81
C	READ THIRD CD.	A	82
C		A	83
	READ (5,410) ITK,IT,EC,CLH(2),CSH(2),IC	A	84
	IF (IC.NE.3) GO TO 100	A	85
	IF (ITK.NE.ITASK) CALL EWRT (4)	A	86
C		A	87
C	READ FOURTH CD.	A	88
C		A	89
	READ (5,420) ITK,T,EI,CLH(3),CSH(3),IC	A	90
	IF (IC.NE.4) GO TO 100	A	91
C		A	92
C	CHECK R11 TOTAL ENG GREATER THAN .3	A	93
C		A	94
	IF (EC(1)+EI(1).LT..20) CALL EWRT (15)	A	95
C		A	96
C	CHECK DOUBLE MANYEARS	A	97
C		A	98
	IF (2.*(EC(1)+EI(1))+.0001.LT.EC(2)+EI(2).OR.EC(1)+EI(1).GT.EC(2)+EI(2)+.0001) CALL EWRT (5)	A	99
	IF (ITK.NE.ITASK) CALL EWRT (4)	A	100
C		A	101
C	READ FIFTH CD.	A	102
C		A	103
	READ (5,430) ITK,IS,CLH(4),CSH(4),IC	A	104
	IF (IC.NE.5) GO TO 100	A	105
	IF (ITK.NE.ITASK) CALL EWRT (4)	A	106
C		A	107
C	CHECK FIRST YR CONF LEVEL	A	108
C		A	109
	IF (CLH(4).GT..7999) CALL EWRT (6)	A	110
C		A	111
		A	112


```

      EDIT.

C      READ SIXTH CC.
C
      READ (5,440) ITK,S,RWU,IC
      IF (IC.NE.6) GO TO 100
      IF (ITK.NE.ITASK) CALL EWRT (4)
C
C      CHECK SYSTEMS + TECH OBJ DATA
C
      DO 160 I=1,15
      IF (IT(I).GT.NTG) CALL EWRT (7)
      IF (IT(I).GT.1.) CALL EWRT (7)
      IF (IS(I).GT.NSY) CALL EWRT (9)
      IF (S(I).GT.1.) CALL EWRT (8)
160  CONTINUE
C      WRITE OUT INPUT DATA + RPT FOR THIS TASK
      IF (.NOT.HCR) GO TO 170
      WRITE (8,290) IDT
      HDR=.NOT.HCR
170  WRITE (8,300) IDIV,ITAT,ITITLE,IR,LIM
      WRITE (8,310)
      ITC=C
      ISC=C
      DO 180 N=1,15
      TS(N)=FLOAT(IS(N))*C1
180  TT(N)=FLOAT(IT(N))*C1
      WRITE (8,320) TT,TS
      WRITE (8,330) T,S
      WRITE (8,340)
      WRITE (8,350) (CLH(N),N=1,4),CS(1),EC(1),EI(1),RWU
      WRITE (8,360) (CSH(N),N=1,4),CS(2),EC(2),EI(2)
      WRITE (8,370)
C      READ CONF LEVEL DATA
      DO 190 I=1,6
      DO 190 J=1,8
190  IFAC(I,J)=0
      CLB=FLCAT((FIX(10.001*CLH(4)))/10.
200  READ (5,450) ITK,CL,DUM,IC
C
C      CHECK CL INCREASING BY .1
C
      IF (ABS(CLB+.1-CL).LT..0001) GO TO 210
      CALL EWRT (9)
      GO TO 100
210  ICL=CL*10.+0.0001
      CAS(ICL)=DUM(1)
      ENC(ICL)=DUM(2)
      ENI(ICL)=DUM(3)
      NV=C
      DO 250 I=1,6
      IF ((DUM(2*I+2).EQ.0.).AND.(DUM(2*I+3).EQ.0.)) GO TO 260
      NV=I
      IL=DUM(2*I+2)*.0001+1.0001
      IF (IL.GT.6) GO TO 230
C
C      CHECK FOR VALID FACILITY CODE
C

```

```

A 113
A 114
A 115
A 116
A 117
A 118
A 119
A 120
A 121
A 122
A 123
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A 125
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A 129
A 130
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A 137
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A 140
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A 142
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A 165
A 166
A 167
A 168

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      EDIT.

      IFAC(I,ICL)=DUM(2*I+2)+.0001
      DO 220 K=1,80
      IF (IFAC(I,ICL).EQ.LF(IL,K)) GO TO 240
220  CONTINUE
230  CALL EWRT (11)
      C
      C CHECK FOR AKA ZERO OCC HRS ON FAC CODES
      C
240  OCC(I,ICL)=DUM(2*I+3)
      IF ((IFAC(I,ICL).NE.0).AND.(OCC(I,ICL).EQ.0)) CALL EWRT (11)
      IF ((OCC(I,ICL).NE.0).AND.(IFAC(I,ICL).EQ.0)) CALL EWRT (12)
250  CONTINUE
260  IF (INV.LE.0) WRITE (8,380) ICL,CAS(ICL),ENC(ICL),ENI(ICL)
      IF (INV.GT.0) WRITE (8,380) ICL,CAS(ICL),ENC(ICL),ENI(ICL),(IFAC(NR
1,ICL),OCC(NR,ICL),NR=1,NV)
      C ADJUST INITIAL RESOURCES IF FIRST YR IS NOT EVEN TENTH
      IF (CLH(4)-CLB.LT..001.OR.IC.GT.7) GO TO 270
      DEN=(CLB+.1-CLH(4))*IC.
      CAS(ICL)=CAS(ICL)/DEN+.001
      ENC(ICL)=ENC(ICL)/DEN+.001
      ENI(ICL)=ENI(ICL)/DEN+.001
270  CLB=CL
      IF (ICL.LT.8) GO TO 200
      C WRITE INPUT DATA FOR THIS TASK ON MASTER FILE
      ITAT=ITAT+ICIV*10000000
      IF (.NOT.ERROR) WRITE (1) ITAT,NAMT,ISYM,LEXT,NAMP,LIM,IR,ITITLE,C
1S,EC,EI,CLF,CSH,IT,T,IS,S,RWU,CAS,ENC,ENI,IFAC,OCC
      GO TO 100
280  IF (IK.NE.NT) CALL EWRT (13)
      IF (.NOT.EPROR) WRITE (6,460)
      C
      C WRITE TRLP
      C
      C WRITE (1) (ITASK,I=1,240)
      END FILE 1
      REWIND 1
      STOP
      C
290  FORMAT (1F15.3X26HRDE FY 1969 INPUT DATA39X2A6)
300  FORMAT (1F2/10HODIVISION 12,7X4HTASK11C,4X5HTITLE4X8A6,4X2HAR13,7X
118HLIMITED WAR DATA/11LX2HLW2X2HSW2X2HIN2X2HCS2X2HLG/11CX5(A2,2X
2))
310  FORMAT (2CX23HSUPPORT OF TECH OBJS42X20HSUPPORT OF SYSTEMS)
320  FORMAT (5H TO 15(1XF3.3),5X4HSYS 15(1XF2.2))
330  FORMAT (5H SUP 15(3H .F1.1),5X4HSUP 15(2H .F1.1)///)
340  FORMAT (15X7H-HISTORY21X1PHFY.- 69 RESOURCES/8X2H655X2H665X2H675X2
1H6817X2HCS4X4HENG03X5HENG1H20X22HASSOCIATED 1498 WORK,6H UNITS)
350  FORMAT (3H CL4F7.2,8X3HRL13F8.1,15X10A5)
360  FORMAT (3H CS4F7.1,8X3HRL23F8.1//)
370  FORMAT (23HC CL VS. RESOURCE DATA35X21HFACILITY UTILIZATION/3H C
1L5X2HCS3X4HENG02X5HENG1H5X6(17HFACILITY OCC 1/27X6(17H CODE
2 HOURS))
380  FORMAT (2H .I1,3F7.1,2X6(1S,F9.C))
390  FORMAT (18,2A6,A3,A1,2A5,4A6,5A2,F3.C,13)
400  FORMAT (18,7A6,A4,5X,2F4.,1,2X2F4.C,13)
410  FORMAT (18,1X15I3,5X,2F4.,0,2X2F4.C,13)

```

EDIT.

```

420  FORMAT (I8,1X15F3.0,5X,2F4.0,2X2F4.0,I3)
430  FORMAT (I8,1X15I2.30X2F4.0,I3)
440  FORMAT (I8,1X15F2.0,1CA3,8XI3)
450  FORMAT (I8,F3.1,3F5.0,12F4.0,3XI3)
460  FORMAT (16#1NO INPUT ERRORS//4H0EOJ)
      END

```

```

A 225
A 226
A 227
A 228
A 229
A 230-

```

EWRT.

	SUBROUTINE EWRT (I)	B	2
C		B	3
C	RTN TO WRITE ERROR MSGS FOR EDIT PGM.	B	4
C		B	5
	COMMON /EC/ ERROR,IC,IDT(2),ITASK	B	6
	LOGICAL ERROR	B	7
	IF (I.EQ.1) WRITE (6,100) ITASK,IC	B	8
	IF (I.EQ.2) WRITE (6,110) ITASK	B	9
	IF (I.EQ.3) WRITE (6,120) ITASK	B	10
	IF (I.EQ.4) WRITE (6,130) ITASK,IC	B	11
	IF (I.EQ.5) WRITE (6,140) ITASK	B	12
	IF (I.EQ.6) WRITE (6,150) ITASK	B	13
	IF (I.EQ.7) WRITE (6,160) ITASK	B	14
	IF (I.EQ.8) WRITE (6,170) ITASK	B	15
	IF (I.EQ.9) WRITE (6,180) ITASK,IC	B	16
	IF (I.EQ.10) WRITE (6,190) ITASK,IC	B	17
	IF (I.EQ.11) WRITE (6,200) ITASK,IC	B	18
	IF (I.EQ.12) WRITE (6,210) ITASK,IC	B	19
	IF (I.EQ.13) WRITE (6,220) ITASK,IC	B	20
	IF (I.EQ.14) WRITE (6,230) ITASK	B	21
	IF (I.EQ.15) WRITE (6,240) ITASK	B	22
	ERROR=.TRUE.	B	23
	RETURN	B	24
C		B	25
100	FORMAT (1HC2I10,2X20HCARD OUT OF SEQUENCE)	B	26
110	FORMAT (1FOI10,2X21HINVALID DIVISION CODE)	B	27
120	FORMAT (1FOI10,2X19HAR FACTOR TOO LARGE)	B	28
130	FORMAT (1HO2I10,2X45HPROJ, TASK, OR SUBTASK DISAGREES WITH 01 CARD	B	29
1)		B	30
140	FORMAT (1FCI10,2X29HERROR IN DOUBLE ENGINEER DATA)	B	31
150	FORMAT (1FOI10,2X20HCL68 GREATER THAN .9)	B	32
160	FORMAT (1HOI10,2X22HERROR IN TECH OBJ DATA)	B	33
170	FORMAT (1FCI10,2X28HERROR IN SYSTEM SUPPORT DATA)	B	34
180	FORMAT (1HO2I10,2X31HCONF LEVEL DATA OUT OF SEQUENCE)	B	35
190	FORMAT (1HC2I10,2X21HILLEGAL FACILITY CODE)	B	36
200	FORMAT (1FC2I10,2X21HNO HOURS FOR FAC CODE)	B	37
210	FORMAT (1HC2I10,2X21HNO FAC CODE FOR HOURS)	B	38
220	FORMAT (1HO2I10,2X19HTASK COUNT IN ERROR)	B	39
230	FORMAT (1FOI10,2X20HTASK OUT OF SEQUENCE)	B	40
240	FORMAT (1HOI10,2X36HTOTAL ENGINEERS LESS THAN .3 FOR RL1)	B	41
	END	B	42-

M4

\$IBLDR M4	22 APR 68	M4000000
\$FILE M4	'UNIT01',K(1),READY,INOUT,BIN,BLK=256	M4000001
\$FILE M4	'UNIT08',A(1),READY,INOUT,BCD,BLK=22	M4000002

ERROR

\$TEXT ERROR

				ENTRY	.OPTW.	D	2
BINARY CARD ID.	ERROR002						
00000	000000000014	10000	.OPYW.	OCT	000000000014	OPTION 32 AND 33	D 3
00001	000000000000	10000		DEC	0		D 4
00002	000000000000	10000		DEC	0		D 5
	00000 01111			END			D 6-

EXEC.

C	EXEC RTN TO DRIVE THE RDE PROGRAM	A	2
C		A	3
	LOGICAL DUFAC,DOREP,DOPRO,DORL1,DORL2	A	4
	COMMON /EX/ BUDG(5),DUFAC,DUREP,DOPRO,DORL1,DORL2,IDT(2),IY,NT,CFN	A	5
	IG, LASTY	A	6
C		A	7
C	USE OF THE LOGICAL VARIABLES - WHEN SET TRUE --	A	8
C		A	9
C	DUFAC - PRODUCE FACILITY LISTING TAPE AS INPUT TO SORT	A	10
C	DOREP - PRODUCE RJ,RJ',TECH OBJ MATRICIES AND LIMWAR AND	A	11
C	WORK UNIT LISTINGS	A	12
C	DORL1 - PRODUCE OPTIMAL ALLOCATION USING ONLY RESOURCE LEVEL 1	A	13
C	DORL2 - PRODUCE OPTIMAL ALLOCATION USING ONLY RESOURCE LEVEL 2	A	14
C	DOPRO - PRODUCE SYSTEM AND TECH. OBJ. PROFILES	A	15
C		A	16
C	TAPE UTILIZATION --	A	17
C		A	18
C	LOGICAL	USED	A
C	UNIT	IN	A
C			A
C	1 INPUT MASTER FILE	EXEC,INIT,FNAL	A
C	7 WORK TAPE	EXEC,INIT,RJP	A
C	3 PRINT FILE FOR B(J)' REPORTS	BJP	A
C	11 FACILITY DATA INPUT TO SORT	EXEC,BJP ,SMLP,FNAL	A
C			A
	CALL DATE (IDT)		A
	REWIND 1		A
	READ (5,110) DUFAC,DOREP,DOPRO,DORL1,DORL2		A
	READ (5,120) LASTY,BUDG		A
	IF (LASTY.GT.5) LASTY=5		A
	WRITE (6,140) (I,BUDG(I),I=1,LASTY)		A
	CALL INIT		A
	REWIND 1		A
	REWIND 7		A
	CALL RJP		A
	IF (LASTY.LE.0) STOP		A
	REWIND 7		A
	DO 100 IY=1,LASTY		A
	REWIND 11		A
100	CALL SMLP		A
	REWIND 1		A
	REWIND 11		A
	IF (LASTY.GT.1) CALL FINAL		A
	REWIND 11		A
	WRITE (6,130)		A
	STOP		A
C			A
110	FORMAT (5L5)		A
120	FORMAT (15,5E10.0)		A
130	FORMAT (4H1EOJ)		A
140	FORMAT (5(1X6HYEAR =12,4X8HBUDGET =F7.0/1)		A
	END		A

DATA.

	BLOCK DATA	B	2
	COMMON /EX/ BUDG(5),DUFAC,DUREP,DOPRO,DORL1,DORL2,IDT(2),IY,NT,CFN	B	3
	IG,LASTY	B	4
	COMMON /TASK/ BJ(16),BP(16),CLH(4),COST(2),CSH(4),CS(2),	B	5
1	CSUM(6),EC(2),EI(2),IS(15),IT(15),ITITLE(8,250),	B	6
2	LIM(5),NPH(14,28),RWU(10),S(15),T(15),	B	7
3	TG(117)	B	8
	COMMON /FIVE/ CLY(250,6),ITP(250),LR(250,5),PER(250),	B	9
1	TBJ(16),TGK(117)	B	10
	DATA CENG/12,7/	B	11
C		B	12
C	TBJ=TIME FOR SYSTEM COMPLETION	B	13
C		B	14
	DATA (TBJ(1),1=1,16)/2*2.,3.,5*2.,4.,2*2.,4.,3.,4.,2*0./	B	15
C		B	16
C	TGK=TIME FOR TECH OBJ COMPLETION	B	17
C		B	18
	DATA (TGK(1),1=1,117)/2.,9.,2.,5.,2.,2.,6.,2.,3.,3.,3*2.,3.,	B	19
1	3*2.,11.,3.,4.,2.,2.,6*3.,3*2.,6.,6.,2.,	B	20
2	9.,6.,7.,6.,7.,6.,2.,3.,2.,3.,3.,6.,2.,	B	21
3	5.,3.,3.,2.,3.,2.,6.,2.,3.,8.,2.,6.,3*3.,	B	22
4	2.,6.,3*2.,6.,5.,4.,4.,3.,	B	23
5	4.,3.,2*2.,6.,2.,6.,2.,4.,7*2.,3.,4.,6.,	B	24
6	2.,4.,2.,2*4.,2.,3.,4.,6.,4.,4*2.,2*3.,	B	25
7	2.,6.,2.,2.,3.,2.,2.,3.,2.,0./	B	26
	DATA (NPH(1,K),K=1,12)/	B	27
	1 60HSTRUCTURAL TESTING OF FLIGHT VEHICLES	, B	28
	2 60HSTRUCTURAL DESIGN CRITERIA	, B	29
	3 60HSTRUCTURAL DESIGN CONCEPTS	, B	30
	4 60HSTRUCTURAL ANALYSIS METHODS	, B	31
	5 60HAERODYNAMICS AND FLIGHT MECHANICS	, B	32
	6 60H EXPERIMENTAL SIMULATION OF FLIGHT MECHANICS	, B	33
	7 60HFLIGHT PATH ANALYSIS	, B	34
	8 60HAIRFRAME - EXHAUST NOZZLE INTEGRATION	, B	35
	9 60HCONTROL DISPLAY	, B	36
	A 60HSTABILITY AND CONTROL INVESTIGATIONS	, B	37
	B 60HCONTROL DATA SYSTEM AND INSTR. TECHNOLOGY FOR ADV. VEHICLES	, B	38
	C 60HSTORED ENERGY DATA SYS + INSTR. FOR AEROSPACE VEHICLES	/ B	39
	DATA (NPH(1,K),K=13,26)/	B	40
	1 60HFLIGHT CONTROL EQUIPMENT TECHNIQUES	, B	41
	2 60HFLIGHT CTL SYS TECH FOR STABILIZATION + CTL OF ADV VEHICLES	, B	42
	3 60HDYNAMIC PROBLEMS IN FLIGHT VEHICLES	, B	43
	4 60HAERO - ACOUSTIC PROBLEMS	, B	44
	5 60HDYNAMIC MEASUREMENT AND ANALYSIS TECHNOLOGY	, B	45
	6 60HHIGH INTENSITY SOUND ENVIRONMENT SIMULATION	, B	46
	7 60HENVIRONMENTAL INTERACTIONS	, B	47
	8 60HBEARINGS AND SPECIAL COMPONENTS	, B	48
	9 60HCREW ESCAPE FOR FLIGHT VEHICLES	, B	49
	A 60HMECHANICAL SUBSYSTEMS FOR ADVANCED FLIGHT VEHICLES	, B	50
	B 60HCREW STATION RESEARCH FOR AEROSPACE VEHICLES	, B	51
	C 60HCRYOGENIC COOLING TECHNOLOGY	, B	52
	D 60HPERFORMANCE + DESIGN OF DEPLOYABLE AERODYNAMIC DECELERATORS	, B	53
	E 60HENVIRONMENTAL CONTROL	/ B	54
	END	B	55-

INIT.

	SUBROUTINE INIT	C	2
C		C	3
C	RTN TO PRODUCE INITIAL RPTS + DATA NEC. FOR FURTHER COMP.	C	4
C		C	5
	DIMENSION CE(16),COLS(16),CAS(8),ENC(8),ENI(8),NAMP(4),NAMT(4)	C	6
	LOGICAL DOFAC,DUREP,DOPRO,DURL1,DURL2	C	7
	COMMON /EX/ HUDG(5),DOFAC,DUREP,DOPRO,DURL1,DURL2,IDT(2),IY,NT,CEV	C	8
	IG,LASTY	C	9
	COMMON /BJTG/ CAVG(16)	C	10
	COMMON /TASK/ BJ(16),BP(16),CLH(4),COST(2),CSH(4),CS(2),	C	11
1	CSUM(8),EC(2),EI(2),IS(15),IT(15),ITITLE(8,250),	C	12
2	LIM(3),NPH(14,28),RWU(10),S(15),T(15),	C	13
3	TG(117)	C	14
	DATA (CE(1),COLS(1),I=1,16)/32*0./,IPT,IPC/2*0/,II/IH /	C	15
	IF (DUREP) WRITE (8,230) IDT	C	16
	IF (DUREP) WRITE (6,220) IDT,(K,K=1,16)	C	17
	NT=0	C	18
C		C	19
C	READ IN DATA BY TASK	C	20
C		C	21
100	FEAD (1) ITASK,NAMT,ISYM,LEXT,NAMP,LIM,IR,(ITITLE(J,NT+1),J=1,8),C	C	22
	IS,EC,EI,CLH,CSH,IT,T,IS,S,RWU,CAS,ENC,ENI	C	23
C		C	24
	IF (ITASK.EQ.99999999) GO TO 190	C	25
	NT=NT+1	C	26
C		C	27
C	WRITE LIMVAR DATA	C	28
C		C	29
	DO 110 J=1,5	C	30
	IF (LIM(J).EQ.11) GO TO 110	C	31
	IF (DUREP) WRITE (8,240) ITASK,LIM	C	32
	GO TO 120	C	33
110	CONTINUE	C	34
120	IF (ITASK/10000.EQ.IPT) GO TO 140	C	35
	IPC=IPC+1	C	36
C		C	37
C	CHECK THAT NUMBER OF PROJECTS LESS THAN 28	C	38
C		C	39
	IF (IPC.GT.28) GO TO 210	C	40
	IPT=ITASK/10000	C	41
	DO 130 K=11,14	C	42
C		C	43
C	BUILD ARRAY OF PROJ ENGINEERS	C	44
C		C	45
130	NPH(K,IPC)=NAMP(K-10)	C	46
C		C	47
C	DEVELOP BJ ROW AND COL. SUMS	C	48
C		C	49
140	RE=0.	C	50
	RSUM=0.	C	51
C		C	52
C	ZERO BJ ARRAY	C	53
C		C	54
	DO 150 I=1,16	C	55
150	BJ(I)=0.	C	56


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      INIT.

      DO 160 I=1,15
      IF (IS(I).EQ.0) GO TO 160
      IB=IS(I)
      BJ(IB)=S(I)
      RSUM=RSUM+S(I)
      RE=RE+1.
      COLS(IB)=COLS(IB)+BJ(IB)
      CE(IR)=CE(IR)+1.
160   CCNTINUE
      RAVG=RSUM/RE
C
C   WRITE BJ DATA
C
      IF (DOREP) WRITE (6,250) ITASK,BJ,RAVG
C
C   CCNVERT ENGINEERS TO EQUIVALENT $
C
      DO 170 K=1,2
170   COST(K)=CS(K)+CENG*(EC(K)+EI(K))
      DO 180 K=1,9
180   CSUM(K)=CAS(K)+CENG*(ENC(K)+ENI(K))
C
C   WRITE TASK RECORD
C
      WRITE (7) ITASK,IR,CLH(4),CS,EC,EI,COST,CSUM,BJ,IT,T,RWU
      GO TO 100
C
C   END READ LOOP
C
C   WRITE COL. SUMS
C
190   IF (DOREP) WRITE (6,260) COLS
C
C   COMP AND WRITE COL. AVGS
C
      DO 200 I=1,16
200   CAVG(I)=COLS(I)/CE(I)
      IF (DOREP) WRITE (6,270) CAVG
      RETURN
210   WRITE (6,280)
      STOP
C
220   FORMAT (1H148X15HROE :969      BJ5X,21H VERSUS SYSTEM MATRIX33X2A4/
1/65X7HSYSTEMS53X7HAVERAGE/3X4HTASK4X16I7,3X6HACROSS//)
230   FORMAT (1H16X4HTASK9X11HLIMITED WAR9X11HSPECIAL AIR9X12HINTERDICTI
10N7X5HCLOSE14X9HL7GISTIC15X2A6/42X7HWARFARE30X7HSUPPORT//)
240   FORMAT (5X18,11XA2,18XA2,19XA2,15XA2,20XA2)
250   FORMAT (1X18,3X16(5X1H.F1.1),3XF6.4)
260   FORMAT (1X131(1H-)/6H TOTAL7X16F7.2)
270   FORMAT (1X131(1H-)/9H VERT AVG4X16F7.2)
280   FORMAT (19H1NR PROJ EXCEEDS 28)
      END
C 57
C 58
C 59
C 60
C 61
C 62
C 63
C 64
C 65
C 66
C 67
C 68
C 69
C 70
C 71
C 72
C 73
C 74
C 75
C 76
C 77
C 78
C 79
C 80
C 81
C 82
C 83
C 84
C 85
C 86
C 87
C 88
C 89
C 90
C 91
C 92
C 93
C 94
C 95
C 96
C 97
C 98
C 99
C 100
C 101
C 102
C 103
C 104
C 105
C 106
C 107
C 108-

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BJP.

	SUBROUTINE BJP	D	2
C		D	3
C	RTN TO COMP. BJ' VALUES	D	4
C		D	5
	LOGICAL DOFAC,DOREP,DOPRO,DORL1,DORL2	D	6
	COMMON /EX/ BUDG(5),DOFAC,DJREP,DOPRO,DORL1,DORL2,IDT(2),IY,NT,CEN	D	7
	IG,LASTY	D	8
	COMMON /BJTG/ CAVG(16)	D	9
	COMMON /TASK/ BJ(16),BP(16),CLH(4),COST(2),CSH(4),CS(2),	D	10
1	CSUM(3),EC(2),EI(2),IS(15),IT(15),ITITLE(8,250),	D	11
2	LIM(5),NPH(14,28),RWU(10),S(15),T(15),	D	12
3	TG(117)	D	13
	DIMENSION DMY(17),CJ(16),HK(117)	D	14
C		D	15
C	CJ=SYSTEM WEIGHTS	D	16
C		D	17
	DATA (CJ(J),J=1,16)/.137,.015,.107,.122,.152,.073,.091,.076,	D	18
1	.070,.001,.043,.030,.046,.037,2*0./	D	19
C		D	20
C	HK=TECH OBJ WEIGHTS	D	21
C		D	22
	DATA (HK(J),J=1,117)/.118,.049,.049,.015,.118,.152,.015,.083,	D	23
1	.083,.049,.152,.083,.152,.083,.083,.049,	D	24
2	.015,.118,2*.083,.118,.083,.049,.083,	D	25
3	3*.049,.015,2*.152,.015,.083,.049,.083,	D	26
4	2*.049,.015,.049,2*.015,2*.118,.083,.049,	D	27
5	.083,2*.152,.049,.083,.049,3*.015,.118,	D	28
6	.015,.083,2*.118,.152,3*.049,.015,2*.083,	D	29
7	2*.015,.083,.049,3*.015,	D	30
8	.049,.015,.015,.049,2*.015,.049,2*.015,	D	31
9	2*.118,.083,2*.015,.083,.049,.015,.083,	D	32
A	.049,3*.118,.083,.049,.083,.049,.049,	D	33
B	.083,.015,.049,2*.083,.118,.015,.049,	D	34
C	2*.083,2*.049,.083,.049,.083,.118,.083,	D	35
D	0./	D	36
	IF (DOREP) WRITE (6,280)	D	37
	IF (DOREP) WRITE (9,210) IDT,(K,K=1,61)	D	38
	DO 120 I=1,N	D	39
C		D	40
C	READ A TASK	D	41
C		D	42
	READ (7) ITASK,IR,DMY,HJ,IT,T,RWU	D	43
	IF (DOREP) WRITE (6,270) ITASK,RWU	D	44
	DO 100 J=1,117	D	45
100	TG(J)=0.	D	46
	DO 110 J=1,15	D	47
	IF (IT(J).LT.1) GO TO 110	D	48
	IG=IT(J)	D	49
	TG(IG)=T(J)	D	50
110	CONTINUE	D	51
120	IF (DOREP) WRITE (8,220) ITASK,(TG(J),J=1,61)	D	52
	IF (DOREP) WRITE (6,230) IDT,(K,K=1,16)	D	53
	IF (DOREP) WRITE (8,240) IDT,(K,K=62,117)	D	54
C		D	55
C	REWIND DATA TAPE FOR SECOND PASS	D	56

BJP.

C	REWIND 7	D	57
	NU 200 I=1,NT	D	58
	READ (7) ITASK,IR,DHY,BJ,IT,T	D	59
C		D	60
C	CALC BJP	D	61
C		D	62
	DO 130 J=1,16	D	63
130	BP(J)=0.	D	64
	RSUM=C.	D	65
	RE=0.	D	66
	DO 140 J=1,16	D	67
	IF (BJ(J).LT..CC'1) GO TO 14C	D	68
	BP(J)=BJ(J)	D	69
	IF (BP(J).GT.CAVG(J)) BP(J)=BJ(J)*(1.+2.5*(BJ(J)-CAVG(J)))	D	70
	RSUM=RSUM+BP(J)	D	71
	RE=RE+1.	D	72
140	CONTINUE	D	73
	RAVG=RSUM/RE	D	74
	IF (DOREP) WRITE (6,26C) ITASK,BP,RAVG	D	75
C		D	76
C	DEVELOP BP*CJ TERM OF OBJECTIVE FUNCTION	D	77
C		D	78
	DO 150 J=1,16	D	79
150	BP(J)=BP(J)*CJ(J)	D	80
	DO 160 J=1,117	D	81
160	TG(J)=0.	D	82
	RSUM=C.	D	83
	RE=C.	D	84
	DO 180 J=1,15	D	85
	IF (IT(J).LT.1) GO TO 170	D	86
	IG=IT(J)	D	87
	TG(IG)=T(J)	D	88
170	RSUM=RSUM+TG(IG)	D	89
	RE=RE+1.	D	90
180	CONTINUE	D	91
	RAVG=RSUM/RE	D	92
	IF (DORFP) WRITE (8,25C) (TG(J),J=62,117),RAVG,ITASK	D	93
C		D	94
C	DEVELOP IG*HK TERM OF OBJECTIVE FUNCTION	D	95
C		D	96
	DO 190 J=1,117	D	97
190	TG(J)=TG(J)*HK(J)	D	98
200	WRITE (11) ITASK,IR,DHY,BP,TG	D	99
	RETURN	D	100
C		D	101
210	FORMAT (1H145X47HRDE 1969 GK VERSUS TECHNOLOGICAL OBJS MATRIX,5	D	102
	1H PT1 22X2A6//63X1CHTECH OBJS //2X4HTASK22X10(2H1),10(2H2),10(2H	D	103
	23),10(2H4),10(2H5),3H6 6/9X61(1X11))	D	104
220	FORMAT (1X18,1X61F2.1)	D	105
230	FORMAT (1H148X21HRDE 1969 BJ PRIME9X20HVERSUS SYSTEM MATRIX,74	D	106
	1X2A6//65X7HSYSTEMS53X7HAVERAGE/3X4HTASK,4X16I7,3X6HACROSS//)	D	107
240	FORMAT (1H145X47HRDE 1969 GK VERSUS TECHNOLOGICAL OBJS MATRIX,5	D	108
	1H PT2 22X2A6//63X1CHTECH OBJS /2X,76X18(2H1)/2X8(2H6),10(2H7),1	D	109
	20(2H8),10(2H9),10(2H0),8(2H1)/1X56(1X11),2X7HAVERAGE3X4HTASK)	D	110
250	FORMAT (2X56F2.1,F7.3,3X18)	D	111
		D	112

RJP.

260	FORMAT (2X18,15F7.1,3XF6.4)	D 113
270	FORMAT (1X18,6X10A5)	D 114
280	FORMAT (1H13X4HTASK20X29HASSOCIATED 1498 WORK UNITS//)	D 115
	END	D 116-

SMLP.

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SUBROUTINE SMLP
RTN TO SIMULATE LINEAR PGM AND DEVELOP TASK RANK BY RDE

COMMON /EX/ BUDG(5),DOFAC,DUREP,DOPRO,DORL1,DORL2,DT(2),IY,NT,CN
1G,LASTY
COMMON /TASK/ BJ(16),BP(16),CLH(4),COST(2),CSH(4),CS(2),
1 CSUM(8),EC(2),EI(2),IS(15),IT(15),ITITLE(8,250),
2 LIM(5),NPH(14,28),RWU(10),S(15),T(15),
3 TG(117)
COMMON /FIVE/ CLY(250,6),ITP(250),LR(250,5),PER(250),
1 TBJ(16),TGK(117)
DIMENSION ALAR(4),CL(2),CLP(250),CSP(250),DN(5),DT(4),
1 ECP(250),EIP(250),IPRL(250),IRAYK(250),LRP(250),
2 NOH(3,5),OBJ(2),OBJP(250),PART(5),PRL(250),
3 PT(4),RATIO(250),TB(2)
DATA (DN(I),I=1,5)/ 30.,35.,67.,19.,37./
LOGICAL DOFAC,DUREP,DUPRO,DURL1,DURL2
LOGICAL WRITEL
DATA (NOH(1,1),I=1,5) /18HSTRUCTURES ,
1 18HFLIGHT MECHANICS ,
2 18HFLIGHT CONTROL ,
3 18HVEHICLE DYNAMICS ,
4 18HVEHICLE EQUIPMENT /
DATA IRLNK,ISNO/1H ,6HNONSEL/,MPR,MOV,MLB/4HPROJ,3HDIV,3HLAB/
IYBAR=IY+1968
YEAR=IY-1
DO 180 I=1,NT
READ (11) ITP(I),IR,CLY(I,1),CS,EC,EI,COST,CSUM,RP,TG
ID=ITP(I)/100000000

GENERATE WEIGHTING FACTOR FROM TASK RANK IN DIV

X=FLOAT(IR-1)/(DN(ID)-1.)
AR=EXP(-X**2)+.37

CALC COST AND GHS COEF FOR EA RESOURCE LEVEL

DO 170 K=1,2
PART(K)=1.
COST(K)=COST(K)+.001
CLB=CLY(I,IY)

FIND TB .LE. 12 YEARS

TB(K)=0.
CLA=CLNU(CLB,COST(K))
IF (TB(K).LT..1) CL(K)=CLA
TB(K)=TB(K)+1.
IF (CLA.GE..8) GO TO 110
CLB=CLA
IF (TB(K).LT.12.) GO TO 100
IF (ABS(CL(K)-.8).GT..0001) GO TO 140
C870.

```

SMLP.

C	CALC % TO REACH .8 IF REACHED THIS YEAR	E	57
C		E	58
	DO 120 J=2,7	E	59
	JJ=9-J	E	60
	IF (CLY(I,IY).GT..1*FLOAT(JJ)) GO TO 130	E	61
120	C8=C8+CSUM(JJ+1)	E	62
130	C8=C8+10.*(0.1*FLOAT(JJ+1)-CLY(I,IY))*CSUM(JJ+1)	E	63
	PART(K)=C8/COST(K)	E	64
	CS(K)=CS(K)*PART(K)	E	65
	EC(K)=EC(K)*PART(K)	E	66
	EI(K)=EI(K)*PART(K)	E	67
	COST(K)=C8	E	68
140	RPSUM=C.	E	69
	DO 150 J=1,16	E	70
	DEN=TRJ(J)-YEAR	E	71
	RPJ=0.	E	72
	IF (DEN.GT..01) RPJ=BP(J)*TIM(T8(K)/DEN)	E	73
150	RPSUM=RPSUM+RPJ	E	74
	TGSUM=0.	E	75
	DO 160 J=1,117	E	76
	DEN=TGK(J)-YEAR	E	77
	TGJ=0.	E	78
	IF (DEN.GT..01) TGJ=TC(J)*TIM(T8(K)/DEN)	E	79
160	TGSUM=TGSUM+TGJ	E	80
170	OBJ(K)=((CL(K)-CLY(I,IY))/CLY(I,IY))*(RPSUM*AR+TGSUM)	E	81
	KP=1	E	82
	IF (OBJ(2)/COST(2).GT.OBJ(1)/COST(1)) KP=2	E	83
	IF (DORL1) KP=1	E	84
	IF (CORL2) KP=2	E	85
	CLP(I)=CL(KP)	E	86
	LRP(I)=KP	E	87
	CSP(I)=CS(KP)	E	88
	ECP(I)=EC(KP)	E	89
	EIP(I)=EI(KP)	E	90
	OBJP(I)=OBJ(KP)	E	91
	IF (CLY(I,IY).LT..799) PER(I)=PART(KP)	E	92
180	RATIO(I)=OBJP(I)/COST(KP)	E	93
	CALL SORT (RATIO,PRL,IPRL,NT,.TRUE.)	E	94
C		E	95
C	WRITE PRIORITY LIST	E	96
C		E	97
	WRITE (6,340) IYEAR,IUT	E	98
	WRITEL=.TRUE.	E	99
	SMCS=0.	E	100
	SMOB=0.	E	101
	SMCST=C.	E	102
	DO 220 I=1,NT	E	103
	IP=IPRL(I)	E	104
	IRANK(IP)=I	E	105
	SMCST=SMCST+CSP(IP)+CENG*(ECP(IP)+EIP(IP))	E	106
	SMCS=SMCS+CSP(IP)	E	107
	SMOB=SMOB+OBJP(IP)	E	108
	IF (SMCS.LE.BUDG(IY)) GO TO 200	E	109
	IF (.NOT.WRITEL) GO TO 190	E	110
	WRITE (6,330)	E	111
	WRITEL=.FALSE.	E	112

SMLP.

190	CLY(IP,IY+1)=CLY(IP,IY)	E 113
	LR(IP,IY+1)=0	E 114
	GO TO 210	E 115
200	CLY(IP,IY+1)=CLP(IP)	E 116
210	LR(IP,IY)=LRP(IP)	E 117
220	WRITE (6,360) I,ITP(IP),(ITITLE(J,IP),J=1,8),LRP(IP),CSP(IP),ECP(I	E 118
	IP),EIP(IP),OBJP(IP),RATIO(IP),SMCS,SMOB,SMCST	E 119
C		E 120
C	WRITE ANNUAL OUTPUT	E 121
C		E 122
	DO 230 K=1,4	E 123
	PT(K)=C.	E 124
	DT(K)=0.	E 125
230	ALAB(K)=0.	E 126
	IDP=ITP(1)/100000000	E 127
	IPP=ITP(1)/10000	E 128
	IPN=1	E 129
	DO 290 I=1,NT	E 130
	ID=ITP(1)/100000000	E 131
	IPROJ=ITP(1)/10000	E 132
	IF (1.EQ.1) GO TO 260	E 133
	IF (IPROJ.EQ.IPP) GO TO 280	E 134
	WRITE (6,320) MPR,PT	E 135
	DO 240 K=1,4	E 136
	DT(K)=DT(K)+PT(K)	E 137
240	PT(K)=C.	E 138
	IPP=IPROJ	E 139
	IPN=IPN+1	E 140
	IF (ID.EQ.IDP) GO TO 270	E 141
	WRITE (6,320) MDV,DT	E 142
	DO 250 K=1,4	E 143
	ALAB(K)=ALAB(K)+DT(K)	E 144
250	DT(K)=0.	E 145
260	IDP=ID	E 146
C		E 147
C	WRITE ANNUAL OUTPUT HDG	E 148
C		E 149
	NY=67+IY	E 150
	NYP1=NY+1	E 151
270	WRITE (6,350) (NDH(J,ID),J=1,3),IYEAR,IDT,IPROJ,(NPH(J,IPN),J=1,14	E 152
	1),NY,NYP1	E 153
280	ITASK=(ITP(1)-IPROJ*10000)+10000	E 154
	ISEL=ISNO	E 155
	IF (ABS(CLY(I,IY+1)-CLY(I,IY)).LT..001) GO TO 290	E 156
	ISEL=IBLNK	E 157
	PT(1)=PT(1)+OBJP(I)	E 158
	PT(2)=PT(2)+CSP(I)	E 159
	PT(3)=PT(3)+ECP(I)	E 160
	PT(4)=PT(4)+EIP(I)	E 161
	NRL=1	E 162
	IF (CLY(I,IY+1).LT.0.) NRL=2	E 163
290	WRITE (6,310) ISEL,ITASK,(ITITLE(J,I),J=1,4),CLY(I,IY),CLY(I,IY+1)	E 164
	1,OBJP(I),CSP(I),ECP(I),EIP(I),LRP(I),IRANK(I),(ITITLE(J,I),J=5,8)	E 165
	DO 300 K=1,4	E 166
	DT(K)=DT(K)+PT(K)	E 167
300	ALAB(K)=ALAB(K)+DT(K)	E 168

SMLP.

	WRITE (6,320) MPR,PT	E 169
	WRITE (6,320) MDV,DT	E 170
	WRITE (6,320) MLR,ALAD	E 171
	RETURN	E 172
C		E 173
310	FORMAT (2XA6,5XI4,6X4A6,2(7XF3.2),F11.4,3F10.2,I6,I13/23X4A6)	E 174
320	FORMAT (70X40(1H-)/53XA4,5X5HTOTALF11.4,3F10.2)	E 175
330	FORMAT (1H)132(1H*)//)	E 176
340	FORMAT (1H156X19HPRIORITY LIST FORI6,41X2A6/1C5X3(6X3HCUM)/13H R	E 177
	1ANK TASK20X5HTITLE26X2HRL4X3HC+S4X4HENG63X5HENG1H3X3HOB5X5HRAT	E 178
	2I06X3HC+S6X3HOB5X4HCUST//)	E 179
350	FORMAT (1H13A6,8HDIVISION24X16HANNUAL OUTPUT I6,47X2A6//9X7HPRNJ	E 180
	1ECT1XI4,7XI4A6/112X6H 8EST 4X7HOVERALL/8H 5X4HTASK13X5HTITL	E 181
	2E18X2HCL13,5X2HCL13,5X3HOB5X7X3HC+S6X4HENG6X5HENG1H6X2HRL9X4HRANK/	E 182
	3/)	E 183
360	FORMAT (14,2XI8,2X7A6,A4,I4,F8.1,2(4XF3.1),F8.3,3XF6.5,F9.1,F9.3,F	E 184
	19.1)	E 185
	END	E 186-

CLNU.

	FUNCTION CLNU (CLIN,CST)	F	2
C		F	3
C	RTN TO UPDATE CONF LEVEL	F	4
C		F	5
	COMMON /TASK/ BJJ(16),HP(16),CLM(4),COST(2),CSH(4),CS(2),	F	6
1	CSUM(8),EC(2),EI(2),IS(15),IT(15),ITITLE(8,250),	F	7
2	LIM(5),NPH(14,28),RWU(10),S(15),T(15),	F	8
3	TG(117)	F	9
	ICL=10.*CLIN+.0001	F	10
	IF (ICL.GE.8) GO TO 120	F	11
	CLNU=.1*FLOAT(ICL)+.00000001	F	12
	DCL=(CLIN-CLNU)*10.	F	13
	DC9=(1.-DCL)*CSUM(ICL+1)-.001	F	14
	IF (CST.GT.DCS) GO TO 100	F	15
	CLNU=CLIN+.1*CST/CSUM(ICL+1)	F	16
	GO TO 110	F	17
100	ICL=ICL+1	F	18
	IF (ICL.GE.8) GO TO 120	F	19
	CLNU=CLNU+.1	F	20
	DC9=DCS+CSUM(ICL+1)	F	21
	IF (CST.GT.DCS) GO TO 100	F	22
	CLNU=CLNU+.1*(CST+CSUM(ICL+1)-DCS)/CSUM(ICL+1)	F	23
110	CLNU=(FLOAT(IFIX(CLNU*100.)))/100.	F	24
	RETURN	F	25
120	CLNU=.8	F	26
	RETURN	F	27
	END	F	28-

TIM.

```

      FUNCTION TIM (TBJ)
C      RTN TO DEVELOP TIMELINESS FUNCTION
C
      TIM=C.
      IF (TBJ.GE.2.) RETURN
      IF (TBJ.GT.1.5) GO TO 100
      IF (TBJ.GT..5) GO TO 110
      TIM=2.*TBJ
      RETURN
100  TIM=4.-2.*TBJ
      RETURN
110  TIM=1.
      RETURN
      END

```

```

G    2
G    3
G    4
G    5
G    6
G    7
G    8
G    9
G   10
G   11
G   12
G   13
G   14
G   15
G  16-

```

SURT.

	SUBROUTINE SORT (XIN,XOUT,LIST,N,DECEND)	H	2
C		H	3
C	RTN TO ORDER ARRAY OF NUMBERS IN ASCENDING OR DESCENDING PRDER	H	4
C		H	5
	LOGICAL DECEND	H	6
	DIMENSION XIN(N), XOUT(N), LIST(N)	H	7
	LIST(1)=1	H	8
	XOUT(1)=XIN(1)	H	9
	DO 150 I=2,N	H	10
	IF (XIN(I).LE.XOUT(I-1)) GO TO 140	H	11
	IT=I-2	H	12
	IF (IT.EQ.0) GO TO 110	H	13
	DO 100 K=1,IT	H	14
	L=I-K-1	H	15
	IF (XIN(I).LE.XOUT(L)) GO TO 120	H	16
100	CCONTINUE	H	17
110	L=0	H	18
120	MS=L+2	H	19
	DO 130 M=MS,I	H	20
	ISUB=I+MS-M	H	21
	XOUT(ISUB)=XOUT(ISUB-1)	H	22
130	LIST(ISUB)=LIST(ISUB-1)	H	23
	XOUT(L+1)=XIN(I)	H	24
	LIST(L+1)=I	H	25
	GO TO 150	H	26
140	XOUT(I)=XIN(I)	H	27
	LIST(I)=I	H	28
150	CCONTINUE	H	29
C		H	30
C	CHANGE ORDER FROM DESCENDING TO ASCENDING.	H	31
C		H	32
	IF (DECEND) RETURN	H	33
	N2=(N+1)/2	H	34
	DO 160 I=1,N2	H	35
	A=XOUT(I)	H	36
	ISUB=N+1-I	H	37
	XOUT(I)=XOUT(ISUB)	H	38
	XOUT(ISUB)=A	H	39
	IA=LIST(I)	H	40
	LIST(I)=LIST(ISUB)	H	41
160	LIST(ISUB)=IA	H	42
	RETURN	H	43
	END	H	44-

FNAL.

	SUBROUTINE FINAL	I	2
C		I	3
C	RTN TO PREP AND WRITE FINAL RPT AND TECH PROFILES	I	4
C		I	5
	COMMON /EX/ BUDG(5),DOFAC,DUREP,DOPRO,DORL1,DORL2,IDT(2),IY,NT,CEN	I	6
	IG, LASTY	I	7
	COMMON /TASK/ BJ(16),BP(16),CLH(4),COST(2),CSH(4),CS(2),	I	8
1	CSUM(8),EC(2),EI(2),IS(15),IT(15),ITITLE(8,250),	I	9
2	LIM(5),NPH(14,28),RWU(10),S(15),T(15),	I	10
3	TG(117)	I	11
	COMMON /FIVE/ CLY(250,6),ITP(250),LR(250,5),PER(250),	I	12
1	TBJ(16),TGK(117)	I	13
	LOGICAL DOFAC,DUREP,DOPRO,DORL1,DORL2	I	14
	DIMENSION IHRS(5), CAS(8), ENC(8), ENI(8)	I	15
	DIMENSION CSO(5),ECU(5),EIO(5),IPRO(250,15),IROW(80),IYAR(6),	I	16
1	TJO(15),TKO(15),ITC(2),ISY(2),	I	17
2	NAMP(4),NAMT(4),IFAC(6,8),OCC(6,8),TS(15),TT(15)	I	18
	DATA IHLNK, (IYAR(I), I=1,6)/IH ,IH8,IH9,IH0,IH1,IH2,IH3/	I	19
	DATA ITC(1)/12H2 TECH OBJ/, ISY(1)/12H1SYS SUPPORT/	I	20
	WRITE (8,320)	I	21
	DO 200 I=1,NT	I	22
	READ (1) ITASK,NAMT,ISYM,LEXT,NAMP,LIM,IR,(ITITLE(J,I),J=1,8),CS,E	I	23
	IC,BI,CLH,CSH,IT,T,IS,S,RWU,CAS,ENC,ENI,IFAC,OCC	I	24
C		I	25
C	WRITE FINAL RPT	I	26
C		I	27
	IF (MOD(I,2).EQ.1) WRITE (6,260) IDT	I	28
	ID=ITASK/10000000	I	29
	WRITE (6,270) ID,ITASK,(ITITLE(J,I),J=1,8),IR	I	30
	DO 100 J=1,15	I	31
	IG=IT(J)	I	32
	TKO(J)=0	I	33
	IF (IG.NE.0) TKO(J)=TGK(IC)*.001	I	34
	IB=IS(J)	I	35
	TJO(J)=0.	I	36
	IF (IB.NE.0) TJO(J)=TBJ(IB)*.01	I	37
	TT(J)=FLOAT(IT(J))*0.01	I	38
	TS(J)=FLOAT(IS(J))*0.1	I	39
100	IF (DOPRO) IPRO(I,J)=IFIX(10.*S(J)+.01)+100*IB+100000*IFIX(10.*T(J	I	40
	1)+.01)+1000000*IG	I	41
	WRITE (6,280) TT,TS,T,S,TKO,TJO	I	42
	DO 110 J=1,5	I	43
	CSO(J)=0.	I	44
	ECO(J)=0.	I	45
110	EIO(J)=0.	I	46
	DO 120 J=1, LASTY	I	47
	IF (ABS(CLY(I,J+1)-CLY(I,J)).LT..0001) GO TO 120	I	48
	PCT=1.	I	49
	IF (CLY(I,J+1).GT..799) PCT=PER(I)	I	50
	NRL=LR(I,J)	I	51
	CSO(J)=CS(NRL)*PCT	I	52
	ECO(J)=EC(NRL)*PCT	I	53
	EIO(J)=EI(NRL)*PCT	I	54
120	CONTINUE	I	55
	WRITE (6,290) CLH,(CLY(I,J),J=2,6),(RWU(J),J=1,5),CSH,CSO,(RWU(J),	I	56

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      FNAL.

      1J=5,10),ECC,EIO,(LR(I,J),J=1,5)
C
C      CHECK FOR TASKS NOT SELECTED FOR 5 YEARS
C
      IF (ABS(CLY(I,1))-CLY(I,6)).GT..0001) GO TO 130
      WRITC (8,300) ITASK,(ITITLE(J,I),J=1,8)
      GO TO 200
130    IF (.NOT.DOFAC) GO TO 200
C
C      WRITE FACILITY PRE-SORT BINARY RECORDS
C
      JS=ABS(CLY(I,1))*10.001
      JT=ABS(CLY(I,6))*10.001
      DO 190 J=JS,JT
      DO 190 K=1,6
      IFC=IFAC(K,J)
      IF (IFC.EQ.0) GO TO 190
      DO 140 L=1,5
140    IHRS(L)=0
      MCLB=J
      DO 180 L=1,5
      MCL=ABS(CLY(I,L+1))*10.001
      IF (MCL.LE.MCLB-1) GO TO 180
      DO 170 M=MCLB,MCL
      DO 150 N=1,6
      IF (IFC.EQ.IFAC(N,M)) GO TO 160
150    CONTINUE
      GO TO 170
160    IHRS(L)=IFIX(OCC(N,M)+.95)+IHRS(L)
170    IFAC(N,M)=0
180    MCLB=MCL+1
      WRITE (11) IFC,ITASK,NAMT,LEXT,IHRS
190    CCNTINUE
200    CCNTINUE
C
C      WRITE TRAILER
C
      IFC=-9999
      WRITE (11) IFC,ITASK,NAMT,LEXT,IHRS
      IF (.NOT.DOPRO) RETURN
C
C      WRITE PROFILE RPT
C
      DO 250 J=1,131
      J1=J-117
      IF (J.LE.117) WRITE (6,300) ITC,J,IDT
      IF (J.GT.117) WRITE (6,300) ISY,J1,IDT
      DO 250 I=1,NT
      DO 210 K=1,15
      KPRO=IPRO(I,K)+11700
      IF (J.LE.117) KPRO=KPRO/100000
      IF (J.EQ.MOD(KPRO,100000)/100) GO TO 220
210    CCNTINUE
      GO TO 250
220    DO 230 M=20,80
230    IROW(M)=IBLNK

```

```

      FNAL.

      DO 240 L=1,5
      KL=7-L
      IL=ABS(CLY(1,KL)*100.)+.01
240   IROW(IL)=IYAK(KL)
      SUP=.1*FLOAT(MOD(KP40,100))
      IF (SUP.GT..699) WRITE (6,310) ITP(1),SUP,(ITITLE(K,1),K=1,8),(190
1W(K),K=20,50)
250   CCNTINUE
      RETURN
C
260   FORMAT (1H130X5CHRDE FY 1959 FINAL REPORT
1 3)X2A6)
270   FORMAT (1H24HDIVISION13,7X4HTASK2X18,6X8A6,20X2HARI4//)
280   FORMAT (20X23HSUPPORT OF TECH OBJ542X20HSUPPORT OF SYSTEMS/5H
1 TO 15(1XF3.3),5X4HSYS 15(1XF2.2)/5H SUP 15(3H .F1.1),5X4HSUP 15
2(2H .F1.1)/5H TK 15(1XF3.3),5X4H TJ 15(1XF2.2)///)
290   FORMAT (51X7HHISTORY49X16HASSOCIATED 1498/15X2H558X2H668X2H673X2H
1688X2H698X2H703X2H718X2H728X2H7314X11HWORK UNITS/4X3HCL 9(7XF3.2)
2,7X5A6/3X4HC+S 9F1.1,7X5A6/3X4HENG40X5F10.1/2X5HENG1H40X5F10.1/4
3X3HRL 39X5110/2(1H0//)
300   FORMAT (2A6,14,40X18HFY 1959 PROFILES44X2A6//3X4HTASK7X3HSUP23Y5
1HTITLE43X17HCONFIDENCE LEVEL /70X2H 29(1H.)1H39(1H.)1H49(1H.)1H50(
21H.)1H69(1H.)1H79(1H.)1H9//)
310   FORMAT (2X18,4XF3.1,3X8A6,3X61A1)
320   FORMAT (1H146X39HTASKS NOT SELECTED FOR FIVE YEARS //)
330   FORMAT (20X18,12X8A6)
      END

```

```

I 113
I 114
I 115
I 116
I 117
I 118
I 119
I 120
I 121
I 122
I 123
I 124
I 125
I 126
I 127
I 128
I 129
I 130
I 131
I 132
I 133
I 134
I 135
I 136
I 137
I 138
I 139-

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UTM40

\$IRLDR	UTM40	16 APR 68	UTM400030
\$FILE	UTM40	'UNIT01',A(1),READY,BIN,INOUT,BLK=26^	UTM400031
\$FILE	UTM40	'UNIT07',A(2),READY,BIN,INOUT,BLK=26^	UTM400032
\$FILE	UTM40	'UNIT08',A(3),READY,BCD,INOUT,BLK=22	UTM400033
\$FILE	UTM40	'UNIT11',K(1),READY,BIN,INOUT,BLK=26^	UTM400034

```

$IBSYS
$EXECUTE      SORT
              OPTION,EQUALS,MAP,CARDS,TAPES
              CHANNELS,INPUT/K1,MERGE/(B,C),OUTPUT/J3
              FILE,INPUT/1,BLO/13,MODE/B
              FILE,OUT,BLO/13,MODE/B
              REC,FIELD/(36B,36B),LEN/(13)
              SORT,FILE/1,ORD/3,FIELD/(2)
              END
$IBSYS
    
```

FACT.

C	RTN TO O/P SORTED FACILITY UTILIZATION DATA	K	2
C		K	3
	DIMENSION ITITLE(11,150)	K	4
	DIMENSION IHRS(5),NAMT(4),IHT(5),IDT(2),IHDR(5,5)	K	5
	DATA FIRST/T/	K	6
	DATA (IHDR(1,1),I=1,5)/	K	7
1	3CHAFFDL-EXISTING FACILITIES	K	9
2	3CH	K	9
3	3CHAFFDL-PROPOSED FACILITIES	K	10
4	3CHCOMPUTER FACILITIES	K	11
5	3CHNGN-AFFDL FACILITIES	K	12
	LOGICAL FIRST	K	13
	CALL DATE (IDT)	K	14
C		K	15
C	BRING IN FAC TITLES	K	16
C		K	17
	DO 100 I=1,150	K	18
	READ (5,250) (ITITLE(J,I),J=1,11)	K	19
	IF (ITITLE(1,I).EQ.0) GO TO 110	K	20
100	CONTINUE	K	21
	WRITE (6,270)	K	22
	STOP	K	23
110	READ (3) IFC,ITASK,NAMT,LEXT,IHRS	K	24
	IF (IFC.EQ.IFCP) GO TO 180	K	25
	IFCP=IFC	K	26
	IF (.NOT.FIRST) GO TO 120	K	27
	FIRST=.FALSE.	K	28
	GO TO 130	K	29
120	WRITE (6,240) IHT	K	30
	IF (IFC.GT.0) GO TO 130	K	31
C		K	32
C	TRAILER	K	33
C		K	34
	WRITE (6,250)	K	35
	STOP	K	36
C		K	37
C	A FAC HDR CR FAC CHANGE	K	38
C		K	39
130	IFH=IFC/1000	K	40
	IF (IFH.EQ.0) IFH=1	K	41
	IF (IFH.EQ.IFHP) GO TO 140	K	42
	IFHP=IFH	K	43
	WRITE (6,200) (IHDR(J,IFH),J=1,5),IDT	K	44
	WRITE (6,210)	K	45
C		K	46
C	SCAN FOR FAC TITLE SUBSCR	K	47
C		K	48
140	DO 150 I=1,150	K	49
	IF (IFC.EQ.ITITLE(1,I)) GO TO 160	K	50
150	CONTINUE	K	51
160	IFT=ITITLE(1,I)+10000	K	52
	WRITE (6,220) IFT,(ITITLE(J,I),J=2,11)	K	53
C		K	54
C	ZERO SUMS	K	55
C		K	56

FACT.

170	DO 170 I=1,5	K	57
	IHT(I)=0	K	58
C		K	59
C	PROCESS DETAIL LINE	K	60
C		K	61
180	DO 190 I=1,5	K	62
190	IHT(I)=IHT(I)+IHRS(I)	K	63
	WRITE (6,230) ITASK,NAMT,LEXT,IHRS	K	64
	GO TO 110	K	65
C		K	66
200	FORMAT (1H15A6,4CHRDE 1969 FACILITY UTILIZATION REPORT5CX2A6//	K	67
	1)	K	68
210	FORMAT (1H577X24HHOURS - BY FISCAL YEAR/67X2H698X2H708X2H718X2H7	K	69
	128X2H73//)	K	70
220	FORMAT (1X14,3X10A6)	K	71
230	FORMAT (1X18,7X5A6,14X5I10)	K	72
240	FORMAT (1H547X12HTOTAL HOURS5I10///)	K	73
250	FORMAT (4H1EOJ)	K	74
260	FORMAT (14,9A6,A2)	K	75
270	FORMAT (20H200 MANY FAC TITLES)	K	76
	END	K	77-

ASD-TR-68-23

APPENDIX I

PROJECT RDE FY 69 PROGRAM - TIME CHARGE NO. 77601

DEPARTMENT OF THE AIR FORCE
AIR FORCE FLIGHT DYNAMICS LABORATORY (AFSC)
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433



REPLY TO
ATTN OF: FDG

15 AUG 1967

SUBJECT: Project RDE FY 69 Program - Time Charge Nr. 77601

TO: FDC FDD FDF FDM FDT

1. Attached are the input data instructions for the FY '69 Research and Development Effectiveness (RDE) Program.

2. The inputs required to RDE have been considerably simplified and reduced as compared to previous years. The engineer's time required will be minimized. There are 4 forms to be completed by the engineer. These are:

Format I - Confidence Level Work Description and Resources Requirements (This is the core of the Project/Task/Subtask Exploratory Development Plan)

Format II - Support of Laboratory Technical Objectives (Internal Laboratory Technical Communication)

Format III - Systems Payoff List. (For communication to SPO and advanced systems offices)

Format IV - Limited War Support. (Used for SLA reporting)

3. The RDE FY '69 Punch Card Transcript will be accomplished by secretarial or clerical personnel who will be specially instructed by FDP to do this task. This will free the engineer of a rather tedious job and will make for consistent entries. Further communications to the Division will be made regarding this matter.

4. The Resource Schedule Summary Work Sheet, Confidence Level Display Chart and Facility Grid Transcript used last year have been deleted from the input requirements.

5. The objectives of above changes are to:

- Minimize engineer's time expended preparing inputs.
- Improve inputs - fewer errors and misinterpretations.
- Improve input data response time.
- Reduce computer usage time.

6. The Laboratory management uses data derived from the RDE outputs throughout the year for information retrieval, as an aid to Laboratory management decisions and for communication with advanced system offices.

7. In view of the above and to assure accuracy, it is extremely important that task engineers have a thorough understanding of the RDE instructions. Instructions should be reviewed prior to actual preparation of RDE input data. Also, a completed sample input package is included for guidance and reference. Use of prior year input data as a guide where task objective remains unchanged will aid in decreasing input preparation time. If further clarification is required, the following FDP personnel are available:

A. B. Mutt, J. F. Schmidt, Lt. L. Morris
Ext. 55337, 52615, Room 2E27, Bldg. 45

8. Each division office is requested to review all the task/subtask inputs and rank these in priority order according to the importance of the effort to future AF systems in general. The rank for each task/subtask will be inserted on the respective Format I prior to forwarding the four formats (I, II, III, & IV) to FDP.

9. Timely integration of inputs by the Plans Office is required. Submittal of Division inputs to FDP in accordance with attached instructions is required on or before 20 November 1967. One (1) typed original of each input format is required.

10. Management judgement is an essential and integral part of the inputs. Careful consideration and review by all echelons is required to ensure that the resulting product will reflect the best professional judgement available in the Laboratory.

DALE D. DAVIS
Colonel, USAF
Director

8 Atch

1. Guidance for FY'69 Resource Levels
2. Guidance on Confidence Level Work Descriptions
3. Format I
4. Format II
5. Format III
6. Format IV
7. Sample Case
8. Flow Chart of RDE '69 Input Prep.

Cy to: FDP

RDE FY 69
Aug. 67

FY '69 RESOURCE LEVELS

1. Inputs by Laboratory engineers to project RDE for FY 1969 will involve two Resource Levels, namely:

- R.L. 1 - Authorized Exploratory Development Engineering Manpower with FY '69 Estimated Budget Dollars
- R.L. 2 - Double the Authorized Exploratory Development Engineering Manpower with Dollars Required

2. The resource requirements, which make up these Resource Levels, are described below:

Resource Level 1 - Authorized Exploratory Development Engineering Manpower

The engineering manpower shall be the currently authorized engineering manyears used for exploratory development work. The engineering manyears should be separated into contract engineering manyears and in-house engineering manyears to reflect the best mix suitable for the task and the organization involved. Assume adequate technician, clerical and wage board support is available but do not include in manpower; use engineering manyears only. Work should not be subdivided to a point where less than .3 engineering manyears/yr. are required. The Project Resources List attached, shows the authorized FY '68 exploratory development S&E manyears by project; use this manyear estimate for FY '69 as a guide. Since increases in S&E manpower are not considered likely, constant manpower ceilings will be used for Resource Level 1 in successive years.

For FY '69 ceiling funds, use the Project Resources List attached as a guide but reflect any known changes to the figures that might presently be in effect.

For estimating support funds, use realistically expected support funds for in-house work. Prior year support funding should be used as a general guide. Include supply and equipment requirements with unit costs of over \$2500; travel, telephone and Form 9 requirements are not to be included. Also, consider the use of existing and proposed Laboratory facilities and other facilities outside the Laboratory.

Supplies and equipment support shall be considered as being purchased with contract type 610-680 dollars and the total dollars will be used as the task fund requirements.

Resource Level 2 - Double Exploratory Development Engineering Manpower

Use double the authorized exploratory development engineering manyears for the task/subtask level being submitted in RDE FY '69. If the input is at task level, then the manpower should be double the task authorized manpower. If the input is a subtask, it should be double the manpower allotted to that subtask. The manyears should be separated into

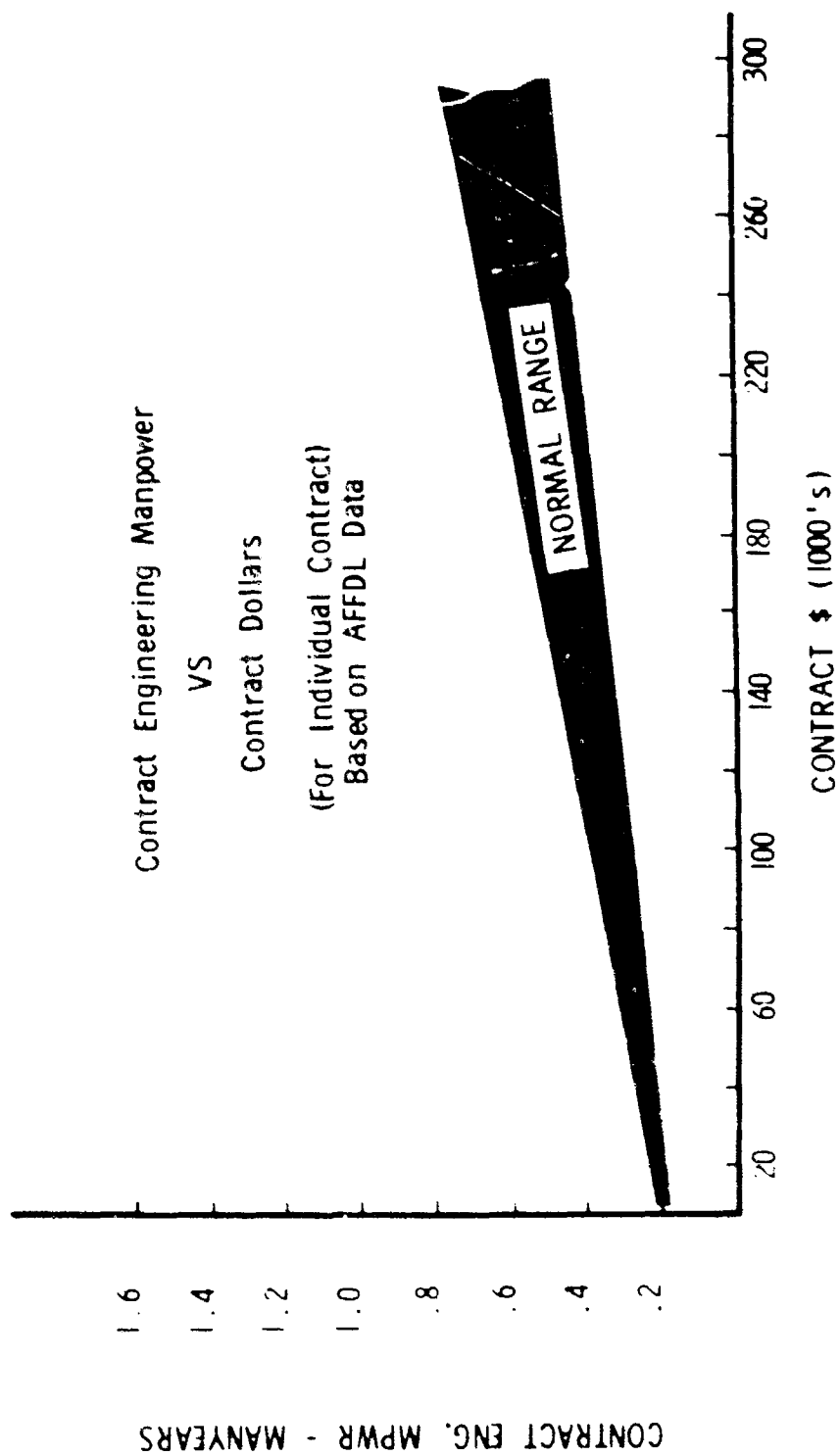
contract engineering manyears and in-house engineering manyears to reflect the best mix suitable for the task and the organization involved. Assume adequate clerical, technician and wage board support is available, but do not include in manpower, use engineering manyears only.

For determining contract funds where experience is not available, consider the increased manyear allocation and use as a guide the attached graph, "Engineer Manpower vs. Contract Dollars."

For estimating support funds, include supply and equipment requirements over \$2500; travel, telephone and Form 9 requirements are to be omitted. Also, consider the use of existing and proposed Laboratory facilities and other facilities outside the Laboratory.

Supplies and equipment shall be considered as being purchased with the contract type 610-680 dollars and the total dollars will be used as the task fund requirements.

3. Based on the above information, the FY '69 resources required should be inserted in the "FY '69 Ceiling Resources Programmed and the Double Engineering Manyrs" spaces provided on the Confidence Level Work Description and Resources Requirements format. (Format #1)



RDE FY 69
Aug. 67

A. CONFIDENCE LEVEL WORK DESCRIPTION GUIDANCE

1. To measure the technical progress of each task, the Confidence Level (C.L.) scale is used. Each task engineer, using the Confidence Level scale definitions included in this attachment, will provide the Confidence Level work descriptions for his particular task/subtask.

2. The Confidence Level scale has a range from .2 to 1.0, and each numerical value within the scale is a Confidence Level. To provide consistency among tasks, the Confidence Level definitions shown on the attached sheet are provided for guidance to the engineer.

3. The exploratory development work necessary to achieve the various sequential Confidence Levels shall be described on the format entitled: "Confidence Level Work Description and Resources Requirements", Format I. (See attached completed example) The work descriptions preparation shall be guided by the following comments.

a. Do not show work descriptions at Confidence Levels lower than the current state-of-the-art. If, for example, current state-of-the-art is at Confidence Level .5, then it is not necessary to describe the work conducted to achieve this level. Describe only the work necessary to achieve .6, .7, .8, .9, and 1.0. Do not use partial Confidence Levels such as .63, .72, .75, etc. Also, do not skip Confidence Levels, i.e., if a C.L. is not involved, insert it, and state, no work required. A task/subtask shall be considered to be at a C.L. of .2 which is considered the origin or start point for a new task. The historical information on C.L. and dollars expended for each task/subtask will be inserted on Format I. This information for prior FY's ('64, '65, '66, & '67) is the same as was submitted in RDE '68 inputs. A copy of these basic inputs will be provided to each project engineer. The entry for FY '68 will be the best estimate of C.L. and dollars expended by end of FY '68.

b. Where applicable, include after the description of work necessary, the facilities needed to attain the Confidence Level indicated. The existing and proposed PDL facilities and other outside facilities required, including the occupancy time, should be entered on the Format I, Reference List of Facilities, attached. Notice that the facilities have been coded to aid in data retrieval. Use the coded facility number on the format. (Contact Mr. Frank Nevius, 55337/52615, for code numbers of those facilities not listed.) For example, if in-house structural tests are required to achieve a C.L. of .5, simply enter the code number 0500 for Structural Test Facility, and number of occupancy hours required. Occupancy hours is defined as the period of time the test facility is occupied and precludes the use of the test facility for any other program.

4. The total task resources required to accomplish the work described for each defined C.L. should be estimated and recorded on the Confidence Level Work Description, Format I. This should be the best estimate the

RDE FY 69
Aug. 67

A. CONFIDENCE LEVEL WORK DESCRIPTION GUIDANCE (Cont'd)

task engineer can make without regard to the ceiling resources. This will indicate what it will cost in dollars and engineering manyears to do the various bits of work described for each defined Confidence Level. The total funds will include contract funds and support funds. It is not necessary to separate these funds, since the support fund requirement will be assumed to be provided from the project funding. The engineering manyears should show the breakout of engineering manyears for monitoring contract work and engineering manyears for in-house work. Estimate the resources required based on your presently used mix on in-house to contract manyears.

RDE FY 69
Aug. 67

CONFIDENCE LEVEL SCALE DEFINITIONS

- 1.0 The current technology is adequate in all respects; detailed design criteria is established.
-
- .9 The current technology is adequate but minor refinements are desirable.
-
- .8 Feasibility has been demonstrated and the current technology is adequate to solve major problems, but improvements in such areas as service life, reliability and efficiency are needed.
-
- .7 Basic design criteria are available, but extensive testing is required to demonstrate actual feasibility (an Advanced Development Program might be required at this point).
-
- .6 Preliminary design criteria are available but a design at this point would be shaky using only the current information.
-
- .5 A complete exploratory development program, which has a high possibility of successful completion using the most promising approach, is defined.
-
- .4 The most promising approach to solution is indicated through exploratory experimentation, analytical effort, and/or simulation.
-
- .3 Preliminary analysis indicates the potential usefulness of the idea and feasible approaches to the problem.
-
- .2 The problem can be defined, and basic idea(s) formulated, but only general approaches to solution are definable.
-

RDE FY 69
Aug. 67

B. SUBTASK IDENTIFICATION GUIDANCE

1. The basic division of work is by task. The task may support one or more systems and Technical Objectives (T.O.'s). The contribution of the task to the systems may vary for different systems. Similarly the contribution to the various T.O.'s may vary. This would be for a standard or normal task. All tasks used in RDE, will be real tasks and not blanket tasks using unauthorized task numbers.
2. Where task resources (manyears and funds) can be divided between subtasks, to reflect contributions to different systems and Technical Objectives, separate subtask Confidence Level work descriptions and resource requirements (Format I) will be prepared.
3. These subtasks will be identified with -1, -2, -3, etc. These subtask (-) numbers will be used for the life of the subtask and once the effort is completed or terminated, the (-) number should not be used again. Contributions of these subtasks to various systems and T.O.'s are handled as with the normal or standard task.
4. The exploratory development engineering manyears for any one subtask in FY69 shall not require less than a total of .3 engineer manyears per year, based on the currently authorized manpower.

RDE FY 69
Aug. 67LIST OF TECHNICAL FACILITIESCODE NRFACILITY DESCRIPTIONI AFDDL EXISTING FACILITIES

NOTE: AFSC Facilities listed below were extracted from
AFSCP 80-3 "Technical Facility Capability Key"

0100	Wind Tunnel, Hypersonic (Gas-Dynamic - 50 MW)
0101	MHD Research Tunnel
0200	Wind Tunnel, Hypersonic (Gas-Dynamic - 4 MW)
0300	Wind Tunnel, Supersonic (Gas-Dynamic - 2 Ft)
0400	Wind Tunnel, Hypersonic (Gas-Dynamic - Pebble Bed)
0500	Structures Test Facility (Aerospace Vehicles)
0501	Induction Heating (RF) Facility
0502	Structures Test Sensor Development Facility)
0503	Heavy Gas Gun Facility
0504	Flight Loads Environmental Facility
0600	Environmental Research Laboratory
0601	Natural Environment Laboratory
0602	Induced Environment Laboratory
0700	Flight Control Simulation Facility (Bldg 192)
0701	Control System Development Facility (Bldg 195)
0800	Landing Gear Test Facility
0900	Decelerator Research Laboratory
0901	Wind Tunnel, Vertical
0902	Wind Tunnel, Subsonic
0903	Water Tow Table
0904	Crew Station Development Laboratory
1000	Bearing Research Laboratory (Aircraft)
1100	Cancelled
1200	Atmosphere Control Laboratory
1300	Environmental Control Laboratory
1400	Structural Dynamics Laboratory (Aerospace Veh)
1401	Runway Profilograph

RDE FY 69
Aug. 67CODE NR FACILITY DESCRIPTION (Cont'd)I AFFDL EXISTING FACILITIES (Cont'd)

1500 Sonic/Acoustical Vibration Facility (Mobile)
 1600 Flight Dynamics Data Analysis Facility
 1700 Flight/Navigation Radioisotope Laboratory
 1800 Flight Research Simulation Facility
 1900 Sonic Fatigue Facility
 1901 Sonic Fatigue Chamber (Large)
 1902 Sonic Fatigue Chamber (Small)
 1903 Noise Facility (Wide Band)
 1904 Acoustic Facility (High Intensity)

II AFFDL PROPOSED FACILITIES

3001 Flight Dynamics Research Laboratory
 3002 Combined Environments Laboratory
 3003 Facility Engineering Laboratory - Bldg 254
 3004 Aerodynamic/Aerothermodynamic Hi Perf Shock Tunnel
 3005 Vibration Aeroelasticity Facility
 3006 Support & Restraint System Variable Acceleration Evaluator
 3007 Landing Gear Model Dynamic Test Facility
 3008 50 MW Magentohydrodynamic Augmentation
 3009 Grappling & Lock-On Vibration Laboratory
 3010 Liquid Hydrogen Test Facility - Structures
 3011 50 MW EGF Contoured Nozzles
 3012 Sonic Fatigue Facility Noise Source Augmentation

III COMPUTER FACILITIES

4001 Bldg 45 - Remote Station IBM 1440
 4002 Bldg 65 - CDC 1604
 4003 Bldg 254 - CDC 160A
 4004 50 Megawatt - Ambilog
 4005 Bldg 434 - MARK II
 4006 Bldg 192 - Simulator
 4007 Sonic Fatigue - Analog
 4008 Bldg 26 - Supersonic 2' Tunnel
 4009 Bldg 45A - FDPE - Data Collection
 4010 Bldg 45 - FDCC - Analog
 4011 Bldg 57 - Digital (SESCD)
 4012 Bldg 57 - Analog (SFSCA)

RDE FY 69
Aug. 67CODE NR FACILITY DESCRIPTION (Cont'd)IV NON-AFFDL FACILITIES

5010	Aerospace Med Res Laboratory
5011	Sixmode
5012	Drop Tower
5013	Centrifuge
5020	AFIT Facilities
5021	5' Low Speed Tunnel
5022	Nuclear Test Facility
5030	Systems Engineering Group Facilities
5040	Aeronautical Systems Division Facilities
5041	Flight Test Support Facility
5050	Arnold Engineering Development Center
5051	Wind Tunnel - 16' Transonic
5052	Wind Tunnel - 16' Supersonic
5053	Wind Tunnel - VKF - 40" Supersonic (A)
5054	Wind Tunnel - VKF - 50" Mach 8 (B)
5055	Wind Tunnel - VKF - 50" Mach 10 (C)
5056	Wind Tunnel - VKF - 12" Supersonic (D)
5057	Wind Tunnel - VKF - 100" Hypervelocity (F)
5058	Wind Tunnel - VKF - 1000' Hypervelocity (G) (Range)
5059	Wind Tunnel - VKF - 50" Hypervelocity (M)
5060	Wind Tunnel - VKF - Hyperballistic Impact Range
5061	Wind Tunnel - V/STOL
5090	Air Force Missile Development Center
5091	Test Track Facility
5092	Drone Launch/Test Facility
5093	Daisy Decelerator Facility
5100	Air Force Eastern Test Range
5110	Air Force Flight Test Center
5111	Parachute Test Facility
5120	National Bureau of Standards
5130	University of Minnesota
5131	SSWT
5132	HLT
5140	Air Proving Ground Center
5141	Missile Range Facility
5150	Braunschweig, Germany - Pre-Flight Drop Test Facility

RDE FY 69
Aug. 67CODE NR FACILITY DESCRIPTION (Cont'd)IV NON-AF/DL FACILITIES (Cont'd)

5160	AF - Navy Data Center (Gov Computer Facility at NYU)
5170	Naval Air Station Lakehurst, New Jersey
5180	AF Special Weapons Center, Kirtland AFB, New Mexico
5190	Princeton Free Flight Facility
5200	AME/PMR Test Range
5210	North American Aviation, Los Angeles
5220	Cornell Aeronautical Laboratories
5230	National Aeronautical & Space Agency
5231	7 X 10' Subsonic Tunnel
5232	40 X 80' Subsonic Tunnel
5233	12' Transonic Pressure Tunnel
5234	14' Transonic Tunnel
5235	Langley 8' Transonic Tunnel
5236	Langley 7 X 10' Hi Speed Tunnel
5237	Langley 7 X 10' Low Speed Tunnel
5238	AES 6' Tunnel
5239	DTW
5240	Langley Unitary Tunnel

RDE FY 69
Aug. 67FORMAT ICONFIDENCE LEVEL WORK DESCRIPTION AND RESOURCES REQUIREMENTS

DATE: _____

Related Current 1498 Work Unit
Nrs. _____

Task/Subtask Nr. _____ Title _____

To & Engr _____ Symbol _____ Tel. Ext. _____ Project Engr. _____ Ext. _____

Goal: (Be specific and quantitative; Max. Time to complete - 10 years)

Resource Levels	(1) FY 69 Ceiling Resources	(2) Double Engr. Manyrs. *	* Show funds required and the Contract and In-House Engr. Mix when total number Engr. Manyrs are doubled.
Total Contract & Support Dollars (1000's)	\$	\$	
Nr. Engr. Manyrs. Contract Monitoring	MY's	MY's	A.R. Division Office
Nr. Engr. Manyrs. In-House Work	MY's	MY's	Applicability Ranking of this task based on importance to future A.F. System in general.
Total Engr. Manyrs.	MY's	MY's	
Historical Information	FY64	FY66	Latest estimate at end of FY68
Confidence Level Achieved			Coordination Br.
Dollars Expended	\$	\$	Div.
Description of Work Necessary (Give concise description of the work to raise Confidence from one Level to next)	To Obtain a Confidence Level of (.3, .4 to 1.0)	Funds in \$1000's	Resources Required Engr. Manyrs. for Contract In-House Monitoring
			Facilities Code Occupancy in Hours

FORMAT I

CONFIDENCE LEVEL WORK DESCRIPTION AND RESOURCES REQUIREMENTS (Cont'd)

[illegible]

RDE FY 69
Aug. 67FORMAT II

Project/Task/Subtask Nr. _____

SUPPORT OF AIR FORCE FLIGHT DYNAMICS LABORATORY
FY-69 Technical Objective (T.O.'s)

For each task/subtask, insert the contribution (.1 to 1.0), this effort makes toward the accomplishment of the respective Technical Objectives. The scale that defines the contribution values is attached.

If your task/subtask supports a T.O. at a contribution of .8 or greater, the Technical Objective engineer's coordination should be entered immediately after the contribution value. The purpose of this coordination is to increase Laboratory engineer-to-engineer communication. Basically, this reflects professional courtesy.

CONTRI- BUTION OF TASK TO T.O.		T.O. NR.	TITLE
CODED RDE	(.1 to 1.0)		
T.O. NR.			
<u>STRUCTURES DIVISION</u>			
<u>FDT</u>			
01		93601	Structural Testing Criteria
02		93602	Thermal Application and Control
03		93603	Turbulence Data Measuring Techniques and Systems
04		93604	Instrumentation for Measuring Structural Response
05		93605	Structural Design for Fiber Reinforced Aircraft Structures
06		93606	Reduction of Aircraft Structural Vulnerability
07		93607	Structural Fastening Techniques
08		93608	Dispersion Strengthened Metal Structures
09		93609	Hyperthermantic Structural Configurations Research
10		93610	Structural Design Concepts for Variable-Geometry Lifting Surfaces for Reentry Vehicles
11		93611	Structural Design Criteria for V/STOL Aircraft
12		93612	Empirical Loads Evaluation, Interpretation, and Analysis
13		93613	Structural Design Criteria for Aerospace Vehicles
14		93614	Structural Analysis Methods
15		93615	Structural Fatigue Analysis Methods
16		93616	Maneuver Loads Dynamic Wind Tunnel Simulation
17		93617	Turbulence Generation System
18		93618	Structures for Hypersonic Vehicle
19		93619	Composite Construction for Flight Vehicle Structures
20		93620	Beryllium Structural Technology

RDE FY 69
Aug. 67

Project/Task/Subtask Nr. _____

CODED RDE T.O. NR.	CONTRI- BUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
FDM			FLIGHT MECHANICS DIVISION
21		91801	Low Speed Characteristics of Hypervelocity Vehicles
22		91802	Supersonic Boundary Layer Control
23		91803	Inlet Boundary Layer Analysis
24		91804	Airframe-Inlet-Engine Compatibility
25		91805	Hypersonic Inlets - Supersonic Combustion
26		91806	Hypersonic Inlets - Dual Mode Combustion
27		91807	Hypersonic Boundary Layer Phenomena
28		91808	Flight Mechanics of Re-entry Wake
29		91809	Aerodynamics of Multicomponent Vehicles
30		91810	Aerodynamics of Hypersonic Configurations
31		91811	Aerodynamics of Low Density Flow
32		91812	Effects of Aerodynamic Heating on Hypervelocity Vehicles
33		91813	Vehicle Physicochemical Environments
34		91814	Vehicle Synthesis Program
35		91815	Performance Simulations Application to Vehicle Operations
36		91816	Maneuverability Optimization
37		91817	Aerothermodynamic Testing Techniques
38		91818	Hypervelocity Gasdynamic Simulation
39		91819	Hypervelocity Flow Measuring Techniques
40		91820	Hypervelocity Facility Magnetohydrodynamic Accelerators
41		91821	Improvement of Experimental Prediction Techniques for V/STOL Configurations
42		91822	Aerodynamic Prediction Techniques for V/STOL Aircraft
43		91823	V/STOL Propulsive Aerodynamics
44		91824	Hypersonic Exhaust Nozzles for Supersonic Combustion Ramjet Applications
45		91825	Airframe - Exhaust Nozzle Integration
46		91826	Hypersonic Vehicles
47		91827	Aerospace Vehicle Integration
48		91828	Facilities for Thermal Testing of Re-entry Heat Protection Materials
49		91829	Hypersonic Variable Geometry Configurations
50		91830	Effect of Ablation on Drag
51		91831	Effect of Nose Blunting on Reacting Boundary
52		91832	Turbulent Reacting Flow
53		91833	Fluid Dynamic Drag in Low Density Flows

RDE FY 69
Aug. 67

Project/Task/Subtask Nr. _____

CODED RDE T.O. NR.	CONTRI- BUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
<u>FDC</u>			<u>FLIGHT CONTROL DIVISION</u>
<u>54</u>		91701	Control System Analysis, Synthesis, and Optimization Techniques
<u>55</u>		91702	Gravity Gradient Techniques at Synchronous Altitude
<u>56</u>		91703	Flexible Vehicle Dynamic Response Control
<u>57</u>		91704	Aerodynamics of Stability and Control
<u>58</u>		91705	V/STOL Stability and Control
<u>59</u>		91706	Handling Qualities Criteria for Aerospace Vehicles
<u>60</u>		91707	Self-Adaptive and Invariant Flight Control Technology
<u>61</u>		91708	Energy Management Concepts
<u>62</u>		91709	Self-Learning Flight Control Systems
<u>63</u>		91710	Space Vehicle Attitude Control and Stabilization Techniques
<u>64</u>		91711	Integrated Flight Control Systems
<u>65</u>		91712	Flight Control Reliability
<u>66</u>		91713	Aerospace Vehicle Flight Control Actuation Techniques
<u>67</u>		91714	Fluidic/Flueric Control Techniques
<u>68</u>		91715	Control Data System Technology
<u>69</u>		91716	Air-Mass Referenced Data Measurement Techniques
<u>70</u>		91717	Vehicle Attitude and Rate Sensing Techniques
<u>71</u>		91718	Exo-Atmosphere Sensing Techniques
<u>72</u>		91719	Transducers for Vehicle Controls in Severe Environmental Conditions
<u>73</u>		91720	Propellant and Propulsion Energy Management Technology
<u>74</u>		91721	Vector Thrust and Thrust Related Parameter Measurement Technology
<u>75</u>		91722	Propellant Data Measurement Technology
<u>76</u>		91723	Propulsion Performance Assessment and Prediction
<u>77</u>		91724	Radiation Resistant Design Techniques
<u>78</u>		91725	Exploitation of Modern Physics Phenomena for Control Data Measurement
<u>79</u>		91727	Wind Tunnel Simulation of Gust and Maneuver Response and Control
<u>80</u>		91728	Display Mechanization Techniques
<u>81</u>		91729	Improvement of Display Interpretation and Readability
<u>82</u>		91730	Takeoff, Letdown, Approach, & Landing Techniques

RDE FY 69
Aug. 67

Project/Task/Subtask Nr. _____

CODED RDE T.O. NR.	CONTRI- BUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
FDC (Cont'd)			
83		91731	FLIGHT CONTROL DIVISION V/STOL Aircraft Control Technology
84		91732	Electrical Primary Flight Control System Techniques
85		91733	Remote Visual Displays
86		91734	Illumination Techniques
87		91735	Primary Flight Controller Design for Transport Aircraft
88		91736	Energy Maneuverability Display Techniques
89		91737	Gas Injection Techniques for Control of Re-entry Vehicles and Interceptors
FDD			
90		93801	VEHICLE DYNAMICS DIVISION Unsteady Aerodynamics
91		93802	Thermoelastic Characteristics of Flexible Structures
92		93803	Dynamic Aerothermoelastic Problems and Criteria
93		93804	Dynamic Load Technology for Aircraft
94		93805	Dynamic Load Technology for Aerospace Vehicles
95		93806	Flight Vehicle Vibration Prediction and Control
96		93807	Dynamic Measurement and Analysis Technology
97		93808	Flight Vehicle Noise Prediction and Control
98		93809	Simulation of High Intensity Noise and Associated Environments
99		93810	High Intensity Acoustic Testing Techniques
100		93811	Sonic Fatigue of Flight Vehicle Structure
101		93812	Sonic Fatigue Instrumentation Development

RDE FY 69
Aug. 67

Project/Task/Subtask Nr. _____

<u>CODED</u> <u>RDE</u> <u>T.O. NR.</u>	<u>CONTRI-</u> <u>BUTION OF</u> <u>TASK TO T.C.</u> <u>(.1 to 1.0)</u>	<u>T.O. NR.</u>	<u>TITLE</u>
<u>FDF</u>			<u>AEROSPACE VEHICLE EQUIPMENT DIVISION</u>
102		90401	First-Stage Type Aerodynamic Decelerators
103		90402	Aerodynamic Decelerator Landing Point Control
104		90403	Heavy Equipment and Personnel Airdrop Concepts
105		90405	Emergency Crew Escape
106		90406	Personnel Seating and Restraint Systems
107		90407	Aerospace Vehicle Crew Stations
108		90408	Environmental Simulation, Protection, and Test
109		90409	Vehicle Atmosphere Control
110		90410	Aircraft Thermal Control
111		90411	Space Vehicle Thermal Control
112		90412	Cryogenic Cooling
113		90413	Bearings, Bushings, and Special Components (formerly Bearings for Advanced Systems)
114		90414	Lighting Gear System Concepts and Simulation Techniques
115		90417	Aircrew Rescue Capability
116		90418	Personnel Passive Defense Protection

RDE FY 69
Aug. 67

Scale for Task/Subtask Contribution to Technical Objective

Potential Breakthrough -----	1.0
	.9
Major Advancement -----	.8
Average Evolutionary Advancement ---- (Steady Progress)	.6
	.5
Refinement or Improvement -----	.4
	.3
Minor Contribution -----	.2
	.1

NOTE: When a Task or Subtask supports a Technical Objective at a contribution of .8 or greater, the Tech Obj engineer's coordination will be obtained.

RDE FY 69
Aug. 67FORMAT IIISYSTEMS PAYOFF LIST**

Task/Subtask Nr. _____ Title _____

Engr's Name _____ Symbol _____ Tel. Ext. _____

Reports Published Since June 1966
 *Indicate after title (C) for Contract & (IH) for In-House

Title* (C) or (IH)	Report Nr.
_____	_____
_____	_____
_____	_____

BRIEF STATEMENT OF CURRENT STATE-OF-THE-ART FOR THIS TASK (4 Lines Max.)

SYSTEM NR. SUPPORTED	CONTRIBUTION OF TASK TO SYSTEM (.1 to 1.0)	PAYOFF - BRIEFLY STATE (2 TO 3 LINES) IN QUANTITATIVE TERMS, THE SPECIFIC IMPROVEMENT THIS TASK PROVIDES EACH SYSTEM BEYOND THE CURRENT STATE-OF-THE-ART

** If the contribution of task to system exceeds .7, show SPO coordination.
 (Telephone Coordination is acceptable)

System _____ SPO Coordination _____

RDE FY 69
Aug. 69

Instructions for Systems Payoff List Format III

In general, the entries to this form are self explanatory.

- a. Note that Technical Reports published should reflect whether it is a Contract or In-House report.
- b. Use the attached list of RDE 69 systems to obtain identification code number, i.e., 1, 2, 3, 4, 5 Enter the RDE FY 69 identification code numbers for the systems supported by this task/subtask. Insert the contribution value based on the attached contribution to system scale. (.1 thru 1.0)
- c. Several system numbers may be inserted in one block if the contribution value is the same for each system. (See example)
- d. Note that contribution values greater than .7 require the SPO's coordination. Telephone coordination will suffice.
- e. Type the requested information on Format III. Do not merely reference prior year form entries.

RDE FY 69
Aug. 67

Scale for Task/Subtask Contribution to System

Absolutely Essential -----	1.0
Failure to have this technology available will prevent initiation of the system acquisition phase	
Major Contribution -----	.9
This technology makes such a major contribution to this system that if it is not funded by the laboratory the system office will probably fund it to ensure its availability	
Significant Contribution -----	.8
Failure to acquire this technology will result in a significant decrease in one or more of the performance parameters of the system	
Substantial Contribution -----	.7
	.6
Refinement of System Capability -----	.5
	.4
Indirect Contribution -----	.3
	.2
Remote Association -----	.1

RDE FY 69
Oct. 67

The RDE 69 advanced system descriptions are classified and will be provided separately. Each Division office and each project engineer will be furnished a copy.

RDE FY 69
Aug. 67FORMAT IV

Project/Task/Subtask Nr. _____

I. Definitions

Limited War - Armed conflict short of general war, exclusive of incidents, involving the overt engagement of the military forces of two or more nations.

Special Air Warfare - Air Force effort in the following:

a. Counterinsurgency - The entire scope of military, paramilitary, political economic, psychological and civic actions taken by or in conjunction with the government of a nation to defeat insurgency.

b. Unconventional Warfare - Includes the three interrelated fields of guerilla warfare, evasion and escape, and subversion against hostile states. Unconventional warfare operations are conducted within enemy or enemy-controlled territory by predominantly indigenous personnel, usually supported and directed in varying degrees by an external source.

II. Evaluation Scale

Specifically Applicable and Primarily Intended for LW/SW	1.0
	.9
	.8
Substantially contributes to the systems normally . . . . .	.7
associated with LW/SW/COIN e.g., V/STOL and HIT	
Missile, etc.	.6
	.5
	.4
Indirectly Applicable and not Primarily Intended for LW/SW . . . . .	.3
	.2
Remotely Associated with LW/SW . . . . .	.1

Using the above scale and definitions, evaluate the contribution this task/subtask has toward (I) Limited War (LW) and (II) Special Air Warfare (SW). Also, if I or II apply, indicate with an XX which of the 3 other categories (III Interdiction (IN), IV Close Support (CS) and/or V Logistics (LG) are applicable.

Contribution

I. Limited War (LW)	_____
II. Special Air Warfare	_____
III. Interdiction (IN)	_____
IV. Close Support (CS)	_____
V. Logistics (LG)	_____

ROE FY 69
Sept. 67

EXAMPLE INPUT

This example is based on an actual input from last year; some values shown were changed to cover all aspects for example purposes

RDE FY 69
Aug. 67FORMAT ICONFIDENCE LEVEL WORK DESCRIPTION AND RESOURCES REQUIREMENTSDATE: 10 Oct. 66Task/Subtask Nr. 146702-1 Title Thermoelastic Structural Analysis Related Current 1498 Work Unit
Nrs. 006 007Task Engr Gene E. Maddux Symbol FUTR Tel. Ext. 55689 Project Engr. R. Bader Ext. 55551

Goal: (Be specific and quantitative; Max. Time to complete - 10 years)

To develop thermoelastic analysis methods capable of predicting the behavior of complex structures

subjected to severe thermal and load environments.

Resource Levels	(1) FY 69 Ceiling Resources	(2) Double Engr. Manyrs.	* Show funds required and the Contract and In-House Engr. Mix when total number Engr. Manyrs are doubled.
Total Contract & Support Dollars (1000's)	\$90	\$200	
Nr. Engr. Manyrs. Contract Monitoring	.4 MY's	.6 MY's	A.R. 16 Division Office
Nr. Engr. Manyrs. In-House Work	.6 MY's	1.4 MY's	Applicability Ranking of this task based on importance to future A.F. System in general.
Total Engr. Manyrs.	1.0 MY's	2.0 MY's	

Historical Information	FY64	FY65	FY66	FY67	Latest estimate at end of FY68	Coordination
Confidence Level Achieved	.25	.30	.35	.37	.42	Br. F.J. Janick
Dollars Expended	\$115	\$31	\$70	\$136	\$90	Div. R.F. Hoener

Description of Work Necessary
(Give concise description of the work to
raise Confidence from one Level to next)
(.3, .4 to 1.0)Best approach to satisfy the need
chosen. Testing continues.Theoretical background and computer
programming completed. Testing
continues.

Funds in \$1000's	Resources Required		
	Engr. Manyrs. for Contract Monitoring	In-House	Facilities Code Occupancy Nr in Hours
100	.4	.6	0500 4011 500 20
200	.8	1.2	0500 4011 250 20

RDE FY 69
Aug. 67FORMAT ICONFIDENCE LEVEL WORK DESCRIPTION AND RESOURCES REQUIREMENTS (Cont'd)

Task/Subtask Nr.	146702-1	Title	Thermoelastic Structural Analysis					
Description of Work Necessary (Give concise description of the work to raise Confidence from one Level to next)	To Obtain a Confidence Level of (.3, .4 to 1.0)	Funds in \$1000's	Resources Required			Facilities		
			Engr. Manhrs for Contract Monitoring	In-House	Code Nr	Occupancy in Hours		
Experimental program completed. Check out of computer program continues.	.7	200	.8	1.2	0500 4011	250 20		
Final analysis form attained. Minor improvements added.	.8	100	.4	.6	0500 4011	250 20		
Distribution of analyses completed. Feedback from users compiled.	.9	100	.4	.6	—	—		
Analyses completed in which we have 100% confidence in achieving accuracies of 95% or better in determining the exact thermal stress and deformations in a vehicle.	1.0	100	.4	.6	—	—		

RDE FY 69
Aug. 67FORMAT IIProject/Task/Subtask Nr. 146702-1SUPPORT OF AIR FORCE FLIGHT DYNAMICS LABORATORY
FY-6⁰ Technical Objective (T.O.'s)

For each task/subtask, insert the contribution (.1 to 1.0), this effort makes toward the accomplishment of the respective Technical Objectives. The scale that defines the contribution values is attached.

If your task/subtask supports a T.O. at a contribution of .8 or greater, the Technical Objective engineer's coordination should be entered immediately after the contribution value. The purpose of this coordination is to increase Laboratory engineer-to-engineer communication. Basically, this reflects professional courtesy.

CODED RDE T.O. NR.	CONTRI- BUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
<u>FDT</u>			<u>STRUCTURES DIVISION</u>
01	.6	93601	Structural Testing Criteria
02		93602	Thermal Application and Control
03		93603	Turbulence Data Measuring Techniques and Systems
04		93604	Instrumentation for Measuring Structural Response
05	.6	93605	Structural Design for Fiber Reinforced Aircraft Structures
06	.6	93606	Reduction of Aircraft Structural Vulnerability
07		93607	Structural Fastening Techniques
08		93608	Dispersion Strengthened Metal Structures
09	.6	93609	Hyperthermantic Structural Configurations Research
10	.6	93610	Structural Design Concepts for Variable-Geometry Lifting Surfaces for Reentry Vehicles
11		93611	Structural Design Criteria for V/STOL Aircraft
12		93612	Empirical Loads Evaluation, Interpretation, and Analysis
13	.4	93613	Structural Design Criteria for Aerospace Vehicles
14	.9 <i>bad</i>	93614	Structural Analysis Methods
15	.9 <i>bad</i>	93615	Structural Fatigue Analysis Methods
16		93616	Maneuver Loads Dynamic Wind Tunnel Simulation
17		93617	Turbulence Generation System
18	.6	93618	Structures for Hypersonic Vehicles
19	.6	93619	Composite Construction for Flight Vehicle Structures
20		93620	Beryllium Structural Technology

RDE FY 69
Aug. 67Project/Task/Subtask Nr. 146702-1

CODED RDE T.O. NR.	CONTRI- BUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
FDM			FLIGHT MECHANICS DIVISION
21		91801	Low Speed Characteristics of Hypervelocity Vehicles
22		91802	Supersonic Boundary Layer Control
23		91803	Inlet Boundary Layer Analysis
24		91804	Airframe-Inlet-Engine Compatibility
25		91805	Hypersonic Inlets - Supersonic Combustion
26		91806	Hypersonic Inlets - Dual Mode Combustion
27		91807	Hypersonic Boundary Layer Phenomena
28		91808	Flight Mechanics of Re-entry Wake
29		91809	Aerodynamics of Multicomponent Vehicles
30		91810	Aerodynamics of Hypersonic Configurations
31		91811	Aerodynamics of Low Density Flow
32		91812	Effects of Aerodynamic Heating on Hypervelocity Vehicles
33		91813	Vehicle Physiochemical Environments
34		91814	Vehicle Synthesis Program
35		91815	Performance Simulations Application to Vehicle Operations
36		91816	Maneuverability Optimization
37		91817	Aerothermodynamic Testing Techniques
38		91818	Hypervelocity Gasdynamic Simulation
39		91819	Hypervelocity Flow Measuring Techniques
40		91820	Hypervelocity Facility Magnetohydrodynamic Accelerators
41		91821	Improvement of Experimental Prediction Techniques for V/StOL Configurations
42		91822	Aerodynamic Prediction Techniques for V/StOL Aircraft
43		91823	V/StOL Propulsive Aerodynamics
44		91824	Hypersonic Exhaust Nozzles for Supersonic Combustion Ramjet Applications
45	.5	91825	Airframe - Exhaust Nozzle Integration
46	.5	91826	Hypersonic Vehicles
47		91827	Aerospace Vehicle Integration
48		91828	Facilities for Thermal Testing of Re-entry Heat Protection Materials
49		91829	Hypersonic Variable Geometry Configurations
50		91830	Effect of Ablation on Drag
51		91831	Effect of Nose Blunting on Reacting Boundary
52		91832	Turbulent Reacting Flows
53		91833	Fluid Dynamic Drag in Low Density Flows

RDE FY 69
Aug. 67Project/Task/Subtask Nr. 146702-1

CODED RDE T.O. NR.	CONTRI- BUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
<u>FDC</u>			<u>FLIGHT CONTROL DIVISION</u>
54		91701	Control System Analysis, Synthesis, and Optimization Techniques
55		91702	Gravity Gradient Techniques at Synchronous Altitude
56		91703	Flexible Vehicle Dynamic Response Control
57		91704	Aerodynamics of Stability and Control
58		91705	V/STOL Stability and Control
59		91706	Handling Qualities Criteria for Aerospace Vehicles
60		91707	Self-Adaptive and Invariant Flight Control Technology
61		91708	Energy Management Concepts
62		91709	Self-Learning Flight Control Systems
63		91710	Space Vehicle Attitude Control and Stabilization Techniques
64		91711	Integrated Flight Control Systems
65		91712	Flight Control Reliability
66		91713	Aerospace Vehicle Flight Control Actuation Techniques
67		91714	Fluidic/Flueric Control Techniques
68		91715	Control Data System Technology
69		91716	Air-Mass Referenced Data Measurement Techniques
70		91717	Vehicle Attitude and Rate Sensing Techniques
71		91718	Exo-Atmosphere Sensing Techniques
72		91719	Transducers for Vehicle Controls in Severe Environmental Conditions
73		91720	Propellant and Propulsion Energy Management Technology
74		91721	Vector Thrust and Thrust Related Parameter Measurement Technology
75		91722	Propellant Data Measurement Technology
76		91723	Propulsion Performance Assessment and Prediction
77		91724	Radiation Resistant Design Techniques
78		91725	Exploitation of Modern Physics Phenomena for Control Data Measurement
79		91727	Wind Tunnel Simulation of Gust and Maneuver Response and Control
80		91728	Display Mechanization Techniques
81		91729	Improvement of Display Interpretation and Readability
82	.5	91730	Takeoff, Letdown, Approach, & Landing Techniques

RDE FY 69
Aug. 67Project/Task/Subtask Nr. 146702-1

CODED RDE T.O. NR.	CONTRI- BUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
<u>FDC (Cont'd)</u>			
			<u>FLIGHT CONTROL DIVISION</u>
83		91731	V/STOL Aircraft Control Technology
84		91732	Electrical Primary Flight Control System Techniques
85		91733	Remote Visual Displays
86		91734	Illumination Techniques
87		91735	Primary Flight Controller Design for Transport Aircraft
88		91736	Energy Maneuverability Display Techniques
89		91737	Gas Injection Techniques for Control of Re-entry Vehicles and Interceptors
<u>FDD</u>			
			<u>VEHICLE DYNAMICS DIVISION</u>
90		93801	Unsteady Aerodynamics
91	.4	93802	Thermoelastic Characteristics of Flexible Structures
92		93803	Dynamic Aerothermoelastic Problems and Criteria
93		93804	Dynamic Load Technology for Aircraft
94		93805	Dynamic Load Technology for Aerospace Vehicles
95		93806	Flight Vehicle Vibration Prediction and Control
96		93807	Dynamic Measurement and Analysis Technology
97		93808	Flight Vehicle Noise Prediction and Control
98		93809	Simulation of High Intensity Noise and Associated Environments
99		93810	High Intensity Acoustic Testing Techniques
100		93811	Sonic Fatigue of Flight Vehicle Structure
101		93812	Sonic Fatigue Instrumentation Development

RDE FY 69
Aug. 67Project/Task/Subtask Nr. 116702-1

CODED RDE T.O. NR.	CONTRI- BUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
<u>FDF</u>			<u>AEROSPACE VEHICLE EQUIPMENT DIVISION</u>
102		90401	First-Stage Type Aerodynamic Decelerators
103		90402	Aerodynamic Decelerator Landing Point Control
104		90403	Heavy Equipment and Personnel Airdrop Concepts
105		90405	Emergency Crew Escape
106		90406	Personnel Seating and Restraint Systems
107		90407	Aerospace Vehicle Crew Stations
108	.3	90408	Environmental Simulation, Protection, and Test
109		90409	Vehicle Atmosphere Control
110		90410	Aircraft Thermal Control
111		90411	Space Vehicle Thermal Control
112		90412	Cryogenic Cooling
113		90413	Bearings, Bushings, and Special Components (formerly Bearings for Advanced Systems)
114		90414	Aligning Gear System Concepts and Installation Techniques
115		90417	Aircrew Rescue Capability
116		90418	Personnel Passive Defense Protection

RDE FY 69
Aug. 67FORMAT IIISYSTEMS PAYOFF LIST**

Task/Subtask Nr. 146702-1 Title Thermelastic Structural Analysis
 Engr's Name Gene E. Maddux Symbol FDTR Tel. Ext. 55689

Reports Published Since June 1966 *Indicate after title (C) for Contract & (IH) for In-House	Title* (C) or (IH)	Report Nr.
	"Approximate Structural Analysis Techniques" (C)	<u>AFFDL-TR-66-59</u>
	"Experimental Test Program to Verify Thermal Analysis" (C)	<u>AFFDL-TR-66-67</u>
	"Math. Analysis of Heat Conduction" (IH)	<u>AFFDL-TR-66-16</u>

BRIEF STATEMENT OF CURRENT STATE-OF-THE-ART FOR THIS TASK (4 Lines Max.)

Thermal stresses are determined for small portions of a vehicle by both handbook
solutions and large scale digital computer programs. Photoelastic techniques are
being employed to visualize stress patterns.

SYSTEM NR. SUPPORTED	CONTRIBUTION OF TASK TO SYSTEM (.1 to 1.0)	PAYOFF - BRIEFLY STATE (2 TO 3 LINES; IN QUANTITATIVE TERMS, THE SPECIFIC IMPROVEMENT THIS TASK PROVIDES EACH SYSTEM BEYOND THE CURRENT STATE-OF-THE-ART
3,4,7,8, 9,10,11	.6	Improved thermal stress analysis techniques will provide more accurate designs and improved life predictions, thus leading to the ability to carry greater payloads with smaller margins of safety.
6	.5	(Same as above)
16	.8**	(Same as above)

**If the contribution of task to system exceeds .7, show SPO coordination.
 (Telephone Coordination is acceptable)

System SMV-2 SPO Coordination Maj. Rockheart 6/5/66
 7-8

RDE FY 6
Aug. 67FORMAT IVProject/Task/Subtask Nr. 146702-1I. Definitions

Limited War - Armed conflict short of general war, exclusive of incidents, involving the overt engagement of the military forces of two or more nations.

Special Air Warfare - Air Force effort in the following:

- a. Counterinsurgency - The entire scope of military, paramilitary, political economic, psychological and civic actions taken by or in conjunction with the government of a nation to defeat insurgency.
- b. Unconventional Warfare - Includes the three interrelated fields of guerilla warfare, evasion and escape, and subversion against hostile states. Unconventional warfare operations are conducted within enemy or enemy-controlled territory by predominantly indigenous personnel, usually supported and directed in varying degrees by an external source.

II. Evaluation Scale

Specifically Applicable and Primarily Intended for LW/SW

Substantially contributes to the systems normally
associated with LW/SW/COIN e.g., V/STOL and HIT
Missile, etc.

Indirectly Applicable and not Primarily Intended for LW/SW

Remotely Associated with LW/SW

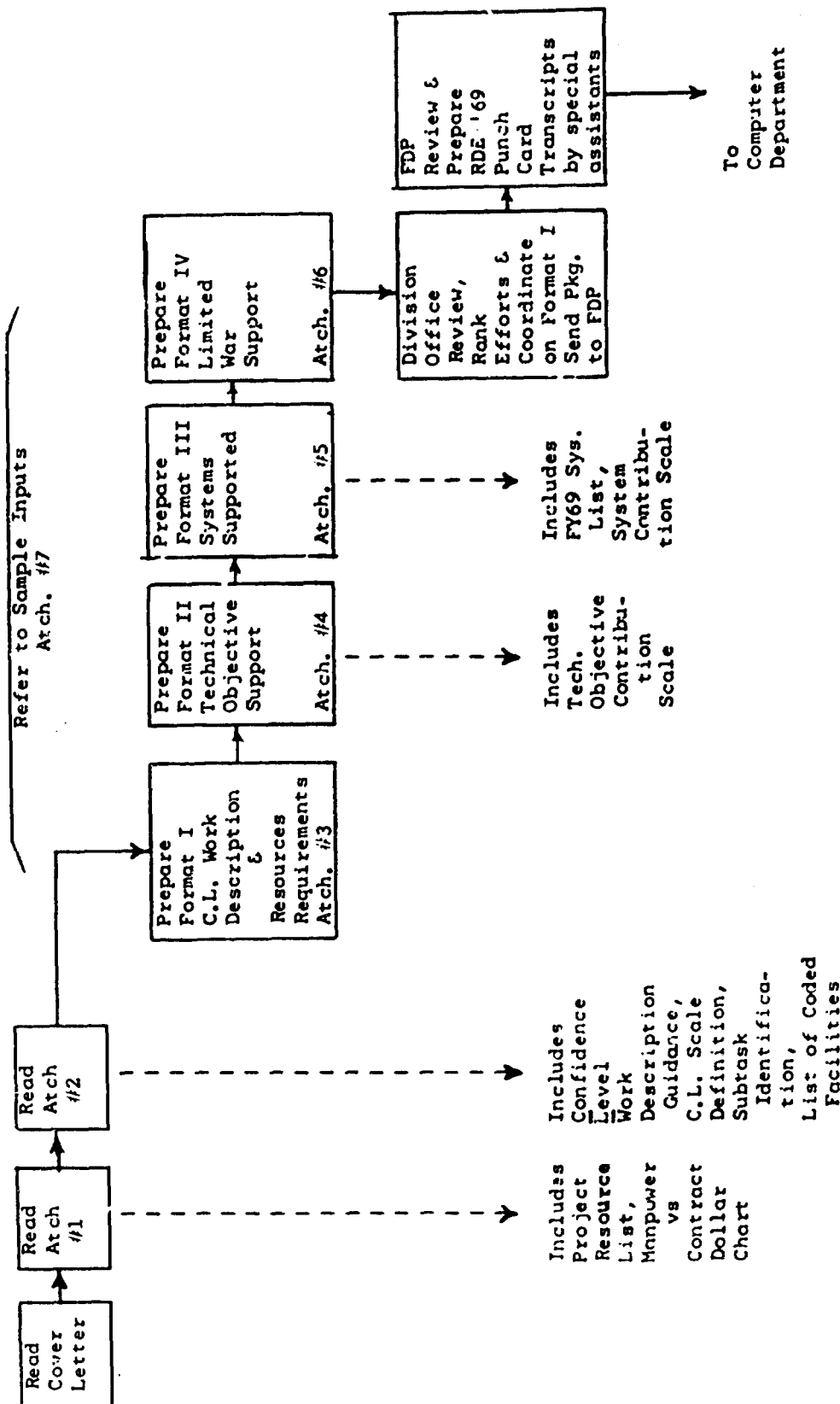
Using the above scale and definitions, evaluate the contribution this task/subtask has toward (I) Limited War (LW) and (II) Special Air Warfare (SW). Also, if I or II apply, indicate with an XX which of the 3 other categories (III Interdiction (IN), IV Close Support (CS) and V Logistics (LG) are applicable.

Contribution

I. Limited War (LW)	<u>.9</u>
II. Special Air Warfare	<u>.9</u>
III. Interdiction (IN)	<u>xx</u>
IV. Close Support (CS)	<u>xx</u>
V. Logistics (LG)	<u>xx</u>

RDE FY 69
Aug. 67

FLOW CHART OF RDE INPUT PREPARATION
(Note all inputs will be typed)



ASD 1005

APPENDIX A
SAMPLE INPUT DATA FOR SPECIFIC TASK

FORMAT I

EDS FY 69
44. 67

CONFERENCE LEVEL WORK DESCRIPTION AND RESOURCES REQUIREMENTS DATE: 10 NOV 1967

Task/Subtask Nr. 134702 Title Measurement of Structural Response Related Current 1498 Work Unit
Task Engr D. C. Fearnow Symbol FDTE Tel. Ext. 54680 Project Engr. V. E. Kearney Ext. 54680
Mrs. 002 003 005 006 007 008 009

Goal: (Be specific and quantitative; Max. Time to complete - 10 years)

Develop instrumentation for structural testing of hypersonic vehicles; develop operational fatigue sensors for hypersonic vehicles; develop nondestructive inspection techniques for determining the static and fatigue strength of supersonic vehicles.

Resource Levels	(1) FY 69 Ceiling Resources	(2) Double Engr. Manyrs.	* Show funds required and the Contract and In-House Engr. Mix when total number Engr. Manyrs are doubled.
Total Contract & Support Dollars (1000's)	\$ 100	\$ 325	
Nr. Engr. Manyrs. Contract Monitoring	.6 MY's	1.2 MY's	A.R. 27 Division Office
Nr. Engr. Manyrs. In-House Work	3.8 MY's	7.6 MY's	Apply City Ranking of this task ba. 1 on importance to future A.F. System in general.
Total Engr. Manyrs.	4.4 MY's	8.8 MY's	

Historical Information	FY64	FY65	FY66	FY67	Latest estimate at end of FY68	Coordination
Confidence Level Achieved	.2	.2	.3	.4	5	Br.
Dollars Expended (1000's)	\$ —	\$ 86	\$ 93	\$ 75	\$ 115	Div.

Description of Work Necessary (Give concise description of the work to raise Confidence from one Level to next)	Resources Required			Facilities Occupancy in Hours
	Funds in \$1000's	Engr. Manyrs. for Contract Monitoring	In-House	
1500°F strain sensors adequate; feasibility of 2000°F demonstrated. The most promising approaches for fatigue sensors and non-destructive inspection are indicated.	100	.3	4.1	1000 350

RDE FY 69
Aug. 67

FORMAT I

CONFIDENCE LEVEL WORK DESCRIPTION AND RESOURCES REQUIREMENTS (Cont'd)

Task/Subtask Nr. 134702		Title Measurement of Structural Response		Resources Required			
Description of Work Necessary (Give a concise description of the work to be accomplished from one level to next)	To Obtain a Confidence Level of (.3, .4 to 1.0)	Funds in \$1000's	Engr. Manhrs for Contract Monitoring	In-House	Facilities Code Nr	Occupancy in Hours	
2000°F strain sensor is adequate but needs minor refinements. Preliminary design criteria are available for operational fatigue sensor. Development program for non-destructive inspection is defined.	.7	100	.3	4.1	0500 0502	300 300	
2000°F strain sensor is fully adequate. Testing necessary to demonstrate feasibility of fatigue sensor. Preliminary design criteria for nondestructive inspection is available.	.8	100	.3	4.1	0500 0502	1000 700	
Adequate technology with some refinements required for this fatigue sensor. Feasibility of nondestructive inspection demonstrated.	.9	100	.3	4.1	0500	2000	
Technology adequate in all respects for operational fatigue sensor and nondestructive inspection techniques.	1.0	100	.3	4.1	0500	500	

12

64 FY
Aug. 67

FORMAT II

Project/Task/Subtask Nr. 134702

SUPPORT OF AIR FORCE FLIGHT DYNAMICS LABORATORY
FY-69 Technical Objective (T.O.'s)

For each task/subtask, insert the contribution (.1 to 1.0), this effort makes toward the accomplishment of the respective Technical Objectives. The scale that defines the contribution values is attached.

If your task/subtask supports a T.O. at a contribution of .8 or greater, the Technical Objective engineer's coordination should be entered immediately after the contribution value. The purpose of this coordination is to increase Laboratory engineer-to-engineer communication. Basically, this reflects professional courtesy.

CODED RDE T.O. NR.	CONTRI- BUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
FDT			STRUCTURES DIVISION
01	.9 W.R. Johnston	93601	Structural Testing Criteria
02	.9 R.A. Noble	93602	Thermal Application and Control
03		93603	Turbulence Data Measuring Techniques and Systems
04		93604	Instrumentation for Measuring Structural Response
05	1.0 J.L. Mullineaux	93605	Structural Design for Fiber Reinforced Aircraft Structures
06	.8 E. Zink	93606	Reduction of Aircraft Structural Vulnerability
07	.9	93607	Structural Fastening Techniques
08	.8	93608	Dispersion Strengthened Metal Structures
09	.9 Nicholson	93609	Hyperthermantic Structural Configurations Research
10	.9	93610	Structural Design Concepts for Variable-Geometry Lifting Surfaces for Reentry Vehicles
11		93611	Structural Design Criteria for V/STOL Aircraft
12		93612	Empirical Loads Evaluation, Interpretation, and Analysis
13		93613	Structural Design Criteria for Aerospace Vehicles
14	.9	93614	Structural Analysis Methods
15	.8 H. Wood	93615	Structural Fatigue Analysis Methods
16		93616	Maneuver Loads Dynamic Wind Tunnel Simulation
17		93617	Turbulence Generation System
18	.9 N.H. Hord	93618	Structures for Hypersonic Vehicles
19	.9 N.H. Hord	93619	Composite Construction for Flight Vehicle Structures
20	.9 F. Barnett	93620	Beryllium Structural Technology

RDE 17 67
Aug. 67

Project/Task/Subtask Nr. 134702

CODD RDE T.O. NR.	CONTRI- BUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
FDM			FLIGHT MECHANICS DIVISION
21		91801	Low Speed Characteristics of Hypervelocity Vehicles
22		91802	Supersonic Boundary Layer Control
23		91803	Inlet Boundary Layer Analysis
24		91804	Airframe-Inlet-Engine Compatibility
25		91805	Hypersonic Inlets - Supersonic Combustion
26		91806	Hypersonic Inlets - Dual Mode Combustion
27		91807	Hypersonic Boundary Layer Phenomena
28		91808	Flight Mechanics of Re-entry Wake
29		91809	Aerodynamics of Multicomponent Vehicles
30		91810	Aerodynamics of Hypersonic Configurations
31		91811	Aerodynamics of Low Density Flow
32	.4	91812	Effects of Aerodynamic Heating on Hypervelocity Vehicles
33		91813	Vehicle Physicochemical Environments
34		91814	Vehicle Synthesis Program
35		91815	Performance Simulations Application to Vehicle Operations
36		91816	Maneuverability Optimization
37		91817	Aerothermodynamic Testing Techniques
38		91818	Hypervelocity Gasdynamic Simulation
39	.2	91819	Hypervelocity Flow Measuring Techniques
40		91820	Hypervelocity Facility Magnetohydrodynamic Accelerators
41		91821	Improvement of Experimental Prediction Techniques for V/STOL Configurations
42		91822	Aerodynamic Prediction Techniques for V/STOL Aircraft
43		91823	V/STOL Propulsive Aerodynamics
44		91824	Hypersonic Exhaust Nozzles for Supersonic Combustion Ramjet Applications
45		91825	Airframe - Exhaust Nozzle Integration
46		91826	Hypersonic Vehicles
47		91827	Aerospace Vehicle Integration
48		91828	Facilities for Thermal Testing of Re-entry Heat Protection Materials
49	.5	91829	Hypersonic Variable Geometry Configuration
50		91830	Effect of Ablation on Drag
51		91831	Effect of Nose Blunting on reacting Boundary
52		91832	Turbulent Reacting Flows
53		91833	Fluid Dynamic Drag in Low Density Flows

RDE FY 69
Aug. 57

Project/Task/Subtask Nr. 134702

CODED RDE T.O. NR.	CONTRI- BUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
FDC			FLIGHT CONTROL DIVISION
54		91701	Control System Analysis, Synthesis, and Optimization Techniques
55		91702	Gravity Gradient Techniques at Synchronous Altitude
56		91703	Flexible Vehicle Dynamic Response Control
57		91704	Aerodynamics of Stability and Control
58		91705	V/STOL Stability and Control
59		91706	Handling Qualities Criteria for Aerospace Vehicles
60		91707	Self-Adaptive and Invariant Flight Control Technology
61		91708	Energy Management Concepts
62		91709	Self-Learning Flight Control Systems
63		91710	Space Vehicle Attitude Control and Stabilization Techniques
64		91711	Integrated Flight Control Systems
65		91712	Flight Control Reliability
66		91713	Aerospace Vehicle Flight Control Actuation Techniques
67		91714	Fluidic/Fluoric Control Techniques
68		91715	Control Data System Technology
69		91716	Air-Mass Referenced Data Measurement Techniques
70		91717	Vehicle Attitude and Rate Sensing Techniques
71		91718	Exo-Atmosphere Sensing Techniques
72		91719	Transducers for Vehicle Controls in Severe Environmental Conditions
73		91720	Propellant and Propulsion Energy Management Technology
74		91721	Vector Thrust and Thrust Related Parameter Measurement Technology
75		91722	Propellant Data Measurement Technology
76		91723	Propulsion Performance Assessment and Prediction
77		91724	Radiation Resistant Design Techniques
78		91725	Exploitation of Modern Physics Phenomena for Control Data Measurement
79		91727	Wind Tunnel Simulation of Gust and Maneuver Response and Control
80		91728	Display Mechanization Techniques
81		91729	Improvement of Display Interpretation and Readability
82		91730	Takeoff, Letdown, Approach, & Landing Techniques

FDL 17 57
Aug. 67

Project/Task/Subtask Nr. 134702

CODED RDE T.O. NR.	CONTRI- BUTION OF TASK TO T.O. (.1 to 1.0)	T.O. NR.	TITLE
FDX (Cont'd)			
FLIGHT CONTROL DIVISION			
83		91731	V/STOL Aircraft Control Technology
84		91732	Electrical Primary Flight Control System Techniques
85		91733	Remote Visual Displays
86		91734	Illumination Techniques
87		91735	Primary Flight Controller Design for Transport Aircraft
88		91736	Energy Maneuverability Display Techniques
89		91737	Gas Injection Techniques for Control of Re-entry Vehicles and Interceptors
FDD			
VEHICLE DYNAMICS DIVISION			
90		93801	Unsteady Aerodynamics
91	.7	93802	Thermoelastic Characteristics of Flexible Structures
92		93803	Dynamic Aerothermoelastic Problems and Criteria
93		93804	Dynamic Load Technology for Aircraft
94		93805	Dynamic Load Technology for Aerospace Vehicles
95		93806	Flight Vehicle Vibration Prediction and Control
96		93807	Dynamic Measurement and Analysis Technology
97		93808	Flight Vehicle Noise Prediction and Control
98		93809	Simulation of High Intensity Noise and Associated Environments
99		93810	High Intensity Acoustic Testing Techniques
100		93811	Sonic Fatigue of Flight Vehicle Structures
101	.8 W.K. Shilling	93812	Sonic Fatigue Instrumentation Development

File # 67
Aug. 67

Project/Task/Subtask Nr. 134702

CONTRIBUTION OF RDE T.O. NR.	T.O. NR.	T.O. NR.	TITLE
			<u>AEROSPACE VEHICLE EQUIPMENT DIVISION</u>
102		90401	First-Stage Type Aerodynamic Decelerator
103		90402	Aerodynamic Decelerator Landing Point Control
104		90403	Heavy Equipment and Personnel Airdrop Concepts
105		90405	Emergency Crew Escape
106		90406	Personnel Seating and Restraint Systems
107		90407	Aerospace Vehicle Crew Stations
108		90408	Environmental Simulation, Protection, and Test
109	.6	90409	Vehicle Atmosphere Control
110		90410	Aircraft Thermal Control
111		90411	Space Vehicle Thermal Control
112		90412	Cryogenic Cooling
113		90413	Bearings, Bushings, and Special Components (formerly Bearings for Advanced Systems)
114		90414	Alighting Gear System Concepts and Simulation Techniques
115		90417	Aircrew Rescue Capability
116		90418	Personnel Passive Defense Protection

RDE FY 69
Aug. 67

FORMAT III

SYSTEMS PAYOFF LIST**

Task/Subtask Nr. 134702 Title Measurement of Structural ResponseEngr's Name Dwight O. Fearnow Symbol FDTE Tel. Ext. 52067

Reports Published Title* (C) or (IH) Report Nr.
 Since June 1966 Design and Construction of a Liquid Level
 *Indicate after Temperature Transducer (IH) AFJOL-TR-66-179
 title (C) for Feasibility Study for the Development of a
 Contract & (IH) Fatigue Damage Indicator (C) AFFDL-TR-6-111
 for In-House Development of a Strain Measuring Standard for
 Temperatures up to 2500°F (C) NBS Report 9535

BRIEF STATEMENT OF CURRENT STATE-OF-THE-ART FOR THIS TASK (4 Lines Max.)

Strain measurement to 1500°F maximum under ideal conditions for short periods. Temp.

measurement to 2800°F long time, 3400°F short time. Surface lab standards to 3000°F.

Fatigue damage indicator feasibility shown at room temperature. Deflection transmission to 3500°F.

SYSTEM NR. SUPPORTED	CONTRIBUTION OF TASK TO SYSTEM (.1 to 1.0)	PAYOFF - BRIEFLY STATE (2 TO 3 LINES) IN QUANTITATIVE TERMS, THE SPECIFIC IMPROVEMENT THIS TASK PROVIDES EACH SYSTEM BEYOND THE CURRENT STATE-OF-THE-ART
5,6,7,8,9, 11,13, and 14.	.6	Structural integrity tests for these systems will draw upon the technology of structural response measurement provided by this task. Specially, elevated temperature strain measurements and temperature distribution measurements are required.
10.	.8	The structural integrity program for this system requires reliable, accurate, long term structural response instrumentation being developed under this task. Elevated temperature strain measurement and elevated temperature fatigue sensors are required.
12	.9	Elevated temperature strain, heat flux, temperature, and deflection measurement is essential to the development of this system.

**If the contribution of task to system exceeds .7, show SPO coordination.
 (Telephone Coordination is acceptable) System 10 No SPO exists. 16 A. 11. 12.

System 10 and 12 SPO Coordination System 12 Mr. Kysiwski
 55627

A. 1

Aug. 67
Aug. 67

FORMAT IV

Project/Task/Subtask Nr. 134702

I. Definitions

Limited War - Armed conflict short of general war, exclusive of incidents, involving the overt engagement of the military forces of two or more nations.

Special Air Warfare - Air Force effort in the following:

- a. Counterinsurgency - The entire scope of military, paramilitary, political economic, psychological and civic actions taken by or in conjunction with the government of a nation to defeat insurgency.
- b. Unconventional Warfare - Includes the three interrelated fields of guerilla warfare, evasion and escape, and subversion against hostile states. Unconventional warfare operations are conducted within enemy or enemy-controlled territory by predominantly indigenous personnel, usually supported and directed in varying degrees by an external source.

II. Evaluation Scale

Specifically Applicable and Primarily Intended for LW/SW	1.0
	.9
	.8
Substantially contributes to the systems normally . . . . .	.7
associated with LW/SW/COIN e.g., V/STOL and HIT	
Missile, etc.	.6
	.5
	.4
Indirectly Applicable and not Primarily Intended for LW/SW . . . . .	.3
	.2
Remotely Associated with LW/SW . . . . .	.1

Using the above scale and definitions, evaluate the contribution this task/subtask has toward (I) Limited War (LW) and (II) Special Air Warfare (SW). Also, if I or II apply, indicate with an XX which of the 3 other categories (III Interdiction (IN), IV Close Support (CS) and/or V Logistics (LG) are applicable.

Contribution

I. Limited War (LW)	<u>.3</u>
II. Special Air Warfare	<u>.3</u>
III. Interdiction (IN)	<u>xx</u>
IV. Close Support (CS)	<u>xx</u>
V. Logistics (LG)	<u>xx</u>

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R&D		
<i>(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)</i>		
1. ORIGINATING ACTIVITY (Corporate author)		2a. REPORT SECURITY CLASSIFICATION
Deputy For Engineering Aeronautical Systems Division Wright-Patterson Air Force Base, Ohio		Unclassified
2b. GROUP		
3. REPORT TITLE		
RESEARCH AND DEVELOPMENT EFFECTIVENESS PROGRAM 1969 (RDE 69) A Management Tool To Allocate the Budget of a Research Organization		
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)		
5. AUTHOR(S) (Last name, first name, initial)		
Robert R. Jurick James F. Bittle, II		
6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
July 1968	141	
8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)	
	ASD-TR-68-23	
9. PROJECT NO.	9b. OTHER REPORT NUMBERS (Any other numbers that may be assigned this report)	
10. AVAILABILITY LIMITATION NOTICES		
This document has been approved for public release and sale; its distribution is unlimited.		
11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY	
	Deputy For Engineering Aeronautical Systems Division Wright-Patterson AFB, Ohio	
13. ABSTRACT		
<p>A formulation and digital computer program is presented as a management tool to allocate the budget of a research organization. It has been designed to meet the specific needs of the Air Force Flight Dynamics Laboratory at Wright-Patterson Air Force Base, Ohio, but instructions are included to enable the program to be used by any research organization. The value of a specific research task is defined and an optimization technique is employed to maximize the total value achieved for a given yearly budget constraint of the organization. A maximum of 250 research tasks may be considered. The program performs a yearly optimization for up to five years. It generates a number of reports which indicate the progress of each research task during the given time period and the effect of this progress on other organizational entities.</p>		

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14.	KEY WORDS	LINK A		LINK B		LINK C	
		ROLE	WT	ROLE	WT	ROLE	WT
	<p>Optimal Resource Allocation For Research Tasks</p> <p>Budgetary Constraint</p> <p>Research Task Objective Coefficient</p>						

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13. ABSTRACT: Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

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There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

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